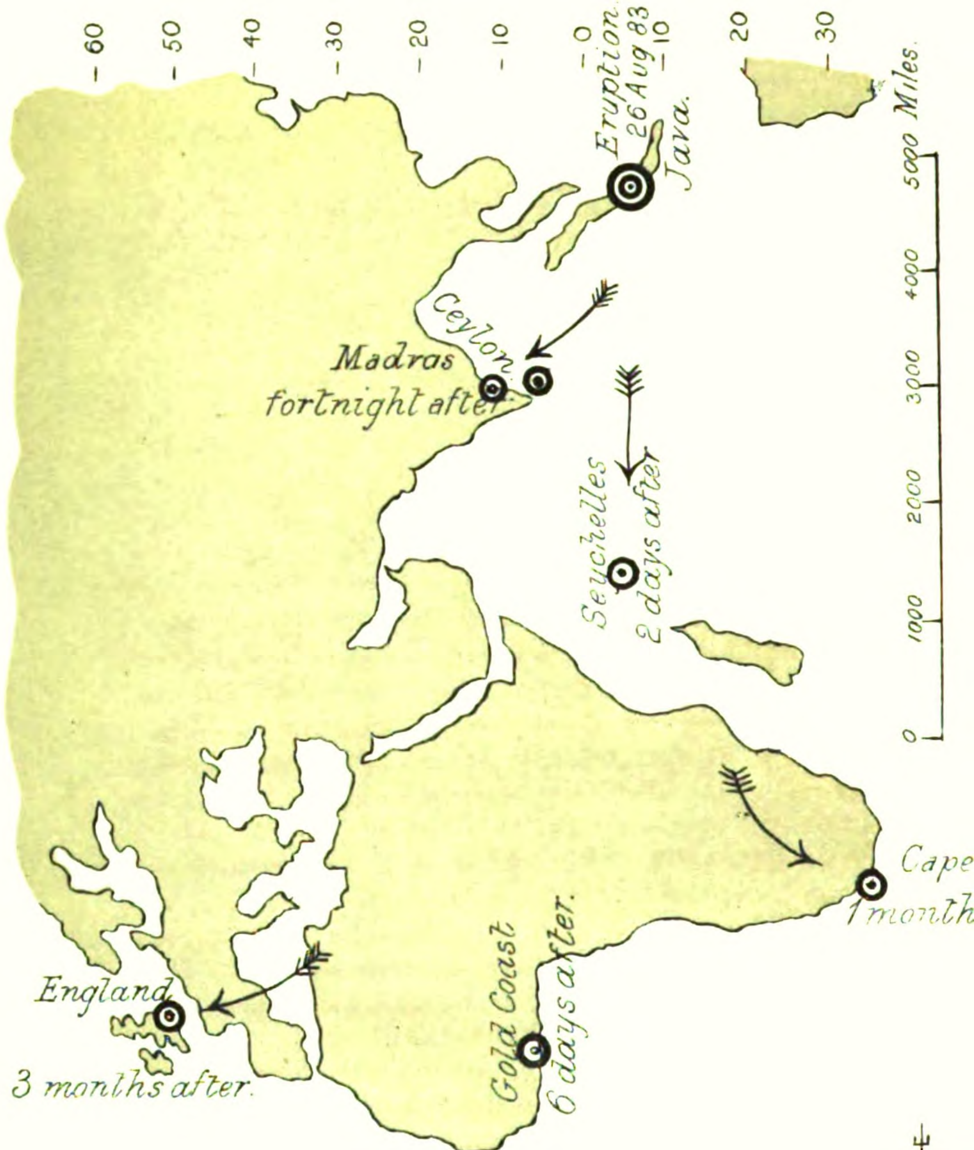
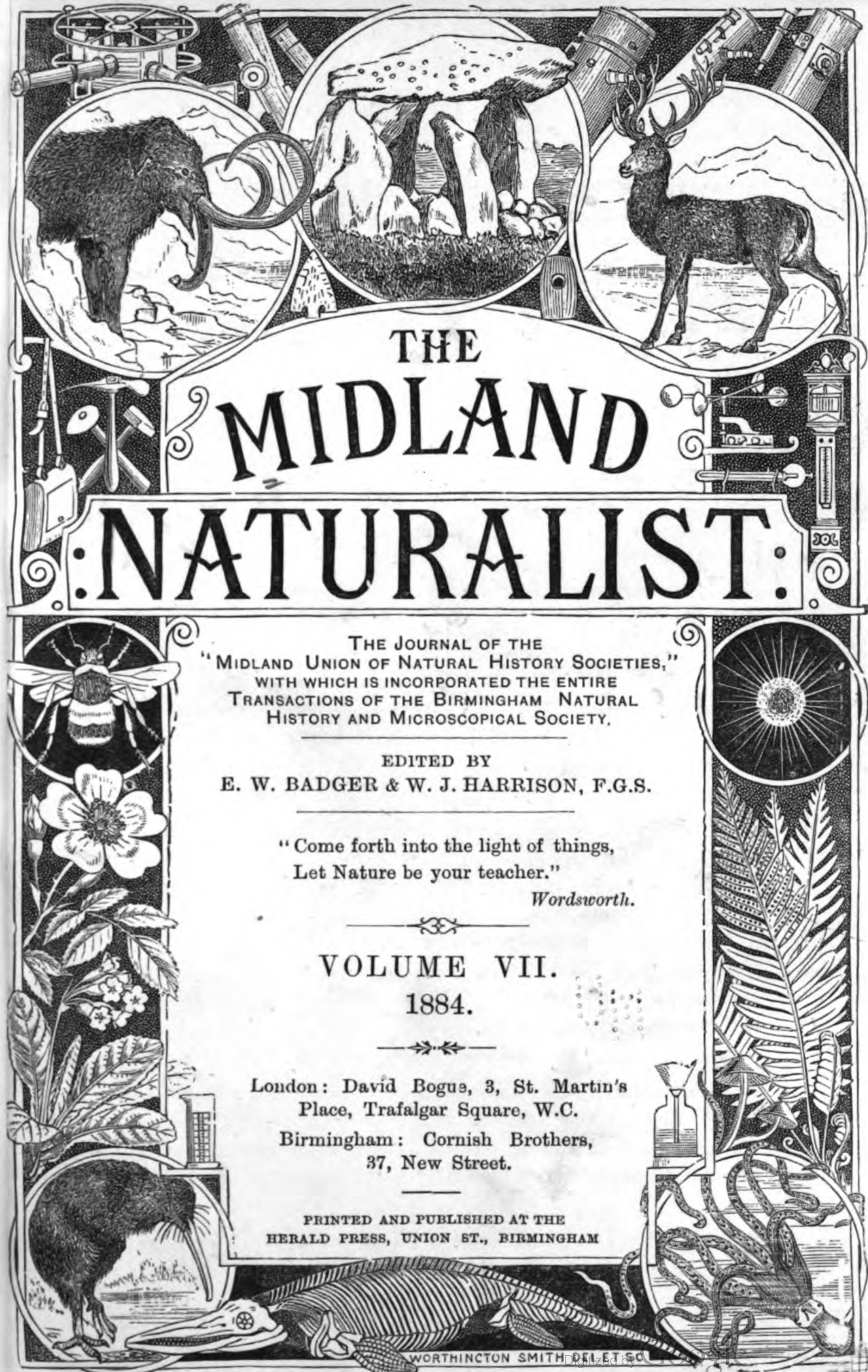


The Midland naturalist

William Jerome Harrison, Midland union of natural history societies, Birmingham Natural History and ...



THE MIDLAND NATURALIST:

THE JOURNAL OF THE
"MIDLAND UNION OF NATURAL HISTORY SOCIETIES,"
WITH WHICH IS INCORPORATED THE ENTIRE
TRANSACTIONS OF THE BIRMINGHAM NATURAL
HISTORY AND MICROSCOPICAL SOCIETY.

EDITED BY
E. W. BADGER & W. J. HARRISON, F.G.S.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

VOLUME VII.
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PREFACE.

The completion of the seventh volume of "The Midland Naturalist," and the character of its contents, form, we trust, a fair subject of congratulation for all who are interested in the progress of science in the Midlands. Owing to the active co-operation of several of the Societies belonging to the Midland Union our circulation has increased during the past year; but when we consider the very favourable terms on which the Magazine is supplied to Members of the Union (through their Secretaries), we hope to see a large increase in the number of subscribers in the year to come.

To our contributors, who have loyally aided us during the past year, we return hearty thanks. They may rest assured that future workers in local science will find it necessary to very frequently refer to our pages. Our critics are earnestly invited—not to discontinue their criticism—but to render their active aid in the improvements which they desire.

We are glad to note that "The Midland Naturalist" is now the sole organ of publication of the Transactions of the Birmingham Natural History and Microscopical Society, and of the Natural History Section of the Leicester Literary and Philosophical Society.

We earnestly ask for the co-operation of all Midland *observers*. In conversation with many friends living in various parts of our district, the Editors find scarcely one who does not mention some newly-discovered section—some rare plant, or insect, or bird lately seen. We appeal to them to put pen to paper, and to communicate to us more frequently the results of their investigations. Hundreds of workers hold back in the hope of *perfecting* their work at some future time —a time which probably never comes.

To the Secretaries of the Societies in the Union we again look for aid in securing good original papers read before their respective Societies. In the matter of increasing our number of subscribers they can also render us most valuable aid.

Finally, we ask help from one and all to render the new volume—for 1885—better than its seven predecessors.

PRINCIPAL CONTRIBUTORS TO THIS VOLUME.

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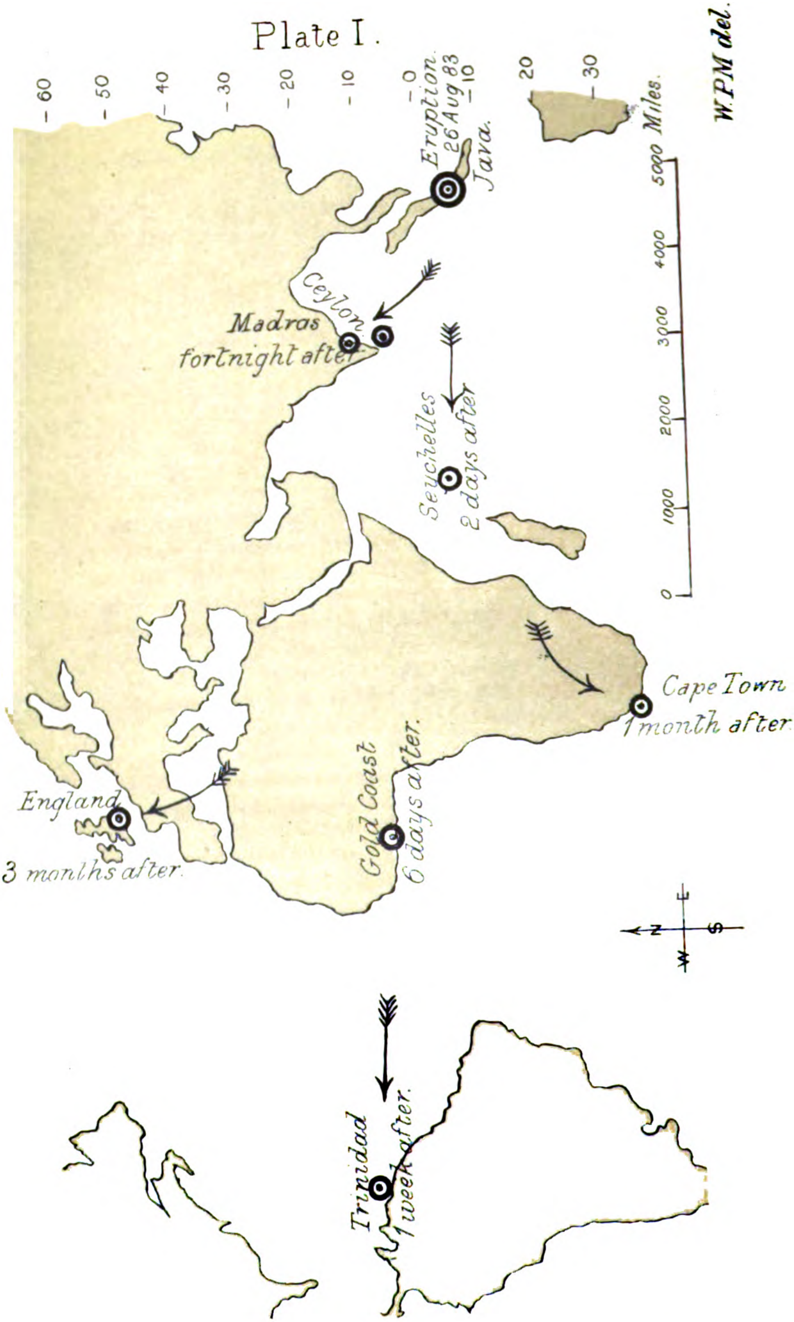

RECENT SUNSETS AND SUNRISES.

THE MIDLAND NATURALIST.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

THE RECENT SUNSETS AND SUNRISES.*

By W. P. Marshall, M.I.C.E.

The very remarkable sunsets and sunrises seen in this country in the latter part of November last were exceptional phenomena, not only from their magnificent display of colour and the great range of the Earth over which they extended, but also from the unusually long period after sunset and before sunrise for which they were seen as compared with the ordinary sunset and sunrise effects, showing that the cause producing the phenomena was situated at a higher level in the atmosphere than the layers of aqueous vapour that produce the ordinary effects. This exceptional occurrence must consequently have had some exceptional cause, and that cause has now been suggested to be the great eruption of a volcano in Java, that occurred at the end of August last, three months previously. This suggestion, although at first appearing a very wild one, has now received so much support from various evidence that it is looked upon by many as the true solution of the difficulty.

This eruption, which occurred in the small island of Krakatoa, between Java and Sumatra, was of exceptionally enormous violence and extent, and is spoken of as the most tremendous volcanic eruption which perhaps has ever occurred in historic times. An island of 3000 feet height disappeared in the eruption, forming a wave of 100 feet height in the sea, which caused great destruction; ashes were discharged to a distance of 250 miles from the volcano, and complete darkness was caused for two days to a distance of more than 30 miles, by a dense continuous downfall of mud and volcanic dust. It is now suggested that in this eruption lava was projected to an extreme height in the atmosphere in the form of minute

* Transactions of the Birmingham Natural History and Microscopical Society. Read at a Meeting of the Society, Dec. 11, 1883.

hollow glassy vesicles, such as may be supposed to be produced by a sudden discharge of very high pressure steam through a layer of melted lava; and that these vesicles, from their extremely small actual weight, and the relatively large surface that they expose to the atmosphere in comparison with their weight, must be many months at least before they can fall down through the atmosphere to the surface of the earth, and during that time they will be liable to be carried by the currents of air to great distances over the earth.

Taking a direct line westward from the volcano (the direction in which the great equatorial currents of the upper regions of the atmosphere travel), the special atmospheric phenomena were observed (as illustrated in the chart, Plate I.) in two days after the eruption at Seychelles Island towards Madagascar; in six days at the Gold Coast on the west of Africa; and in a week at Trinidad in the West Indies. This last place is at a distance of about 12,000 miles from the volcano (half round the earth), travelled in a week, giving an average rate of 70 miles an hour, which is within the rate of observed velocities in the upper regions of the atmosphere. The rate of rotation of the earth's surface at the equator being about 1000 miles an hour (8000 miles diameter, or 24,000 miles circumference travelled in 24 hours), the rate of rotation of the surrounding atmosphere at different heights from the earth's surface may be considered to range between the limits of 1000 miles an hour at the surface of the earth, and nothing where the relatively stationary inter-planetary atmosphere is reached; and at the height of the supposed stratum of volcanic matter, which was estimated at as much as 40 miles by Helmholtz from observations in the special sunsets seen at Berlin, the lagging behind of the atmosphere from its slower rotation, would give the effect upon the earth of a westward current; and 70 miles an hour for such a current would amount to only a small retardation from the 1000 miles an hour surface velocity (only 7 per cent).

The slower lateral dispersion northwards and southwards of the stratum of matter producing the special atmospheric phenomena appears to follow from the circumstances of the successive appearances at different distances north and south, as illustrated in the chart, reaching Madras and Ceylon a fortnight after the eruption, Cape of Good Hope a month after, and England three months after. The special phenomena that have been named at present (mainly from Mr Norman Lockyer's interesting communication to the *Times*) as having been observed at the several places, are as follows :—

In the direct westward course :—

Seychelles—Remarkable sunrises and sunsets, and sun appeared like a full moon.

Gold Coast—Blue sun, and sun white and pale like moon.

Trinidad—Blue sun, and great sunset-glow like a fire.

In the northward and southward dispersion :—

Madras—Green sun at sunrise and sunset.

Ceylon—Green sun and blue sun ; sun blue even at noon.

Cape of Good Hope—Grand and unusual sunsets.

England—Grand and unusual sunsets and sunrises.

TRAP-DOOR SPIDERS IN CAPTIVITY.

For some time past I have had a number of male and female Atypi in confinement in various flower pots, partly filled with sand, and with a layer of moss on the surface to make it more homelike.

Not having seen anything of them for some time, I became anxious to ascertain whether they were living. I carefully lifted the moss in one pot, and found the occupant (a male) dead. In another pot, one almost done for, with abdomen shrivelled and dry, and the legs drawn up. I immediately damped the moss, replacing the glass cover, which was soon covered with moisture. In the evening, on removing the glass, I was surprised and delighted to find Atypus had quite recovered the use of his limbs *and* jaws, for on placing my finger within half an inch of him, he made an attempt to seize it, but I declined such close friendship, having had my thumb's blood drawn pretty freely by a ferocious mate of his. The abdomen, too, had regained its natural form and bright healthy colour.

The spider is, whilst I am writing, enjoying perfect health and spirits. Last week, I mentioned my observations to my friend—Sir Sidney S. Saunders, and he confirmed my opinion that moisture was of the utmost importance for the well-being of spiders in captivity, and informed me that some time ago he kept a large trap-door spider (*Cteniza Ionica*) for a considerable time in confinement, and wishing to see if it would make a door at the bottom of its nest, he reversed it, a proceeding not appreciated by Cteniza, and which it resented by sulking. "I then (said Sir Sidney) obtained the garden watering pot, and gave her a good shower-bath ; the next morning there was the perfect door, which she had made during the night." F. Enock, Woking.

OUR MARINE ALGÆ.*

By Rev. Henry Boyden, B.A.

Our Marine Algæ seem to find little favour among Midland botanists, owing, in some measure, perhaps, to the fact that other cryptogams, as the mosses and fungi so diligently studied, are near at hand, while the sea-weeds are far away. But the Marine Algæ have seldom attracted the attention they deserve. The old classical writers spoke of them in words of contempt. Even Linnæus overlooked them. As the ferns, so widely popular for house and garden decoration in these latter days, were denounced as "hedge-row trumpery" by old medical writers, so the Algæ were seaside trumpery in scientific estimation. Dr. Harvey† and Messrs. Johnstone and Croall,‡ in their splendidly illustrated works on our British sea-weeds, have manifested to the eye, as they also prove to the mind, what perfect treasures of beauty adorn our bays and are cast upon our shores. These writers were largely aided by enthusiastic collectors at different stations on our coast, especially ladies, who had much time and patience at their disposal, and who were rewarded, in some instances, by becoming godmothers in the temple of science, the new species they discovered being called by their names. But even with our modern aids and incentives, how rarely do we find any able to instruct us in regard to our Marine Algæ. I meet now and then with an album containing sea-weeds in a lady's drawing-room, but, unless they were purchased from a professional collector, they are inserted without regard to order, and are unnamed. Yet great facilities exist for the scientific collection of our British Algæ. We have 2,000 miles of English coast, and there are few parts where the plants of Neptune's garden may not be found. For a thorough scientific study of them a continued residence at the seaside is necessary, that the habits of the plants may be observed; but, in these days of cheap excursions, much may be done by an occasional visit. I spent ten days at Felixstowe, on the east coast, last summer, and while there filled an album with sea-weeds for the lady who entertained me, and brought home species that were new to me for the enlargement of my own collection. I also went by a day trip to Llandudno in search of lodgings, and found it possible for an excursionist to look over the place

* Transactions of Birmingham Natural History and Microscopical Society. Read at a General Meeting, Nov. 27, 1883.

† "Phycologia Britannica." ‡ "Nature Printed Sea-Weeds."

and fill a vasculum with sufficient sea-weeds to start a respectable collection, and to occupy a whole winter in the study of them. During the subsequent holiday I spent there I mounted about one hundred specimens, and found some forty different species. As the sea-weeds are arranged on a natural plan, it is necessary that there should be a careful discrimination of all parts of a plant, that it may be assigned to its proper place. These parts are—the root, the frond, and the fructification or reproductive organs.

The *root* generally takes the form of a disc, though in some rare instances it may be of a fibrous nature. Its office is not, as in other plants, to extract nourishment from the earth, but merely to maintain a safe position. The sea has its wild moods, like the aërial ocean in which we vegetate, and its weeds could not exist on the rocks and other places exposed to the violence of the waves, but for the firm grasp of their roots; and tenacious as they are, many are wrenched from their hold and cast ashore by every storm. As the roots are not for nourishment, the plants seem to be, in a large measure, indifferent as to the place where they grow. They fix their home in the sand or mud, or on the hard rock, and in many cases become parasitical, although not truly so, perhaps, as they do not derive nourishment from the other plants on which they grow. Some sea-weeds root themselves on fronds of their own species, and Johnstone and Croall report that they have often seen a specimen of *Laminaria digitata* so completely enveloped by a forest of young Laminariæ, that the poor old parent was well-nigh suffocated by its own progeny. The Laminaria is not the only parent who is overweighted with a multitude of children. I have a piece of the stem of a Laminaria affording a home to a little happy family consisting of *Rhodymenia palmata*, *Delesseria alata*, and *Cladophora rupestris*, to say nothing of the Zoophytes that had founded their colony there. The root of the sea-weed is always small compared with the size of the plant, and in some cases it is entirely absent.

The *fronds* of our Algæ have next to be considered. These are more or less gelatinous in their nature, for which reason many of the specimens adhere to paper without the aid of gum. I have a specimen of *Porphyra laciniata*, which I mounted some twenty years ago, that has been tossed about in frequent exhibitions, but remains almost part of the paper to which it adheres. The gelatine gives substance to the frond, and by the quantity contained the plant is described. If small it is called membranaceous, if abundant and fluid gelatinous, and if firmly fixed it is said to be cartilaginous. These form some of the criteria by which the species of a plant is determined. Fronds vary much in form and colour, and as their configuration, whether simple and entire, or branched, may be taken as an index to the genera, so the colour, whether red, olive-green, or sea-green, with their variety of shades, may serve as an indication of the sub-order to which they belong. It has also to be noticed that fronds vary in their mode of growth, commencing in some cases at the tip of the old frond, and in others at the base. In the filiform genera the branches are "deciduous," a fact that has to be remembered by the collector, as specimens of the same species present very different aspects at the different seasons of the year. In the larger plants of the olive series the fronds are furnished with an intelligent provision in the shape of air-vessels, or bladders, which give buoyancy, enabling them to float on the surface of the water; the bladder-wrack or popweed being a familiar example. But it is the cellular structure of the frond, as examined under the microscope, which above all discriminates the genera and species, and the plants cannot be correctly determined without this aid.

The cells present a variety of forms, as spherical, oval, cylindrical, oblong, quadrate, clavate, etc.; they differ in every species, and even in plants of the same species. Examples come from Jersey in the genus Codium where there is only a single cell, but others are more or less complex in their cellular structure. The stem of these is composed of two or more series of cells; the axial, those which form the centre, and are arranged lengthwise, either bound closely together, or separated by layers of gelatine; and those which form the periphery, at the surface, which are generally smaller and horizontal. When the cells of these series are all of equal length, they appear to be jointed, and the stem is said to be articulate; but when unequal the stem is called inarticulate. Good examples of the former we have in the Polysiphonias.

(To be continued.)

It is announced that Professor Owen has resigned his position as superintendent of the Natural History Department of the British Museum. Though the mania of the anti-vivisectionists has led them to entitle him "an old humbug," because he will not agree with the doctrines of these "peculiar people," there is probably no scientific man in the whole world, outside such craze-mongers, who will not view with regret the announcement that increasing years render such a step necessary. Professor Owen's great services to science have been gratefully and appreciatively recorded in "Nature," not long ago, in an article of the series on "Our Scientific Worthies."

THE SYENITES OF SOUTH LEICESTERSHIRE.

By W. Jerome Harrison, F.G.S.

The traveller going northwards from London passes over a great succession of soft and yielding strata. Sands, clays, and marls, alternating with beds of sandstone and limestone, bear evidence by their position, their character, and by the fossils they contain, that their place is comparatively high in the geological scale. The London Clay hills of Herts, the chalk of the North Downs, the oolitic, liassic, and triassic limestones and clays of Bedfordshire, Northamptonshire, and South Leicestershire, all belong to either the Secondary or the Tertiary Systems of geologists. It is with some surprise then, that the student of science comes in South Leicestershire upon hard crystalline igneous rocks, which must evidently be referred to the Primary Epoch, and which can indeed be proved to take rank among the very oldest rocks in the British Islands.

The rocks to which we are referring are seen at the surface between Enderby on the north-east and Sapcote on the south-west, a distance of 5½ miles, and in a line at right angles to this we have indications of their presence over a width of 2½ miles. But they do not occupy the surface of all the tract just named; the amount of rock actually exposed does not in the aggregate exceed one square mile. They crop out at five distinct points, each of which is surrounded and isolated from the others by the great expanse of red marl and sandstone (the *Keuper Marl* of the Trias) which constitutes so much of the south-west and west of Leicestershire.

The five areas occupied by igneous rocks are as follows:—

1. Enderby.
2. Narborough.
3. Croft.
4. Sapcote and Stoney Stanton.
5. Barrow Hill, near Earl Shilton.

We shall now describe each of these places separately:—

1. *Enderby.*—This is the name of a village lying four and a-half miles south-west of Leicester; standing on elevated ground about one mile west of the River Soar, and distant about a mile and a-half from Narborough Station. Walking from the last-named place, we turn to the right just before entering Enderby, and find ourselves in a very remarkable quarry, lying south-west of and close to the village. The rock we stand upon, and which forms the lower and middle part of the "face" of the pit, is a compact, hard, and excessively tough crystalline rock. Examining it carefully and with the aid of a magnifier, we can make out the minerals of which it is

composed. These are felspar (pinkish or grey) and hornblende (green), with a few grains of quartz. On the whole, this is a rock which may be termed *syenite*. It differs from granite in containing hornblende instead of mica, and in having but little quartz. Here and there we notice patches of a bluish or greenish tint in the rock, but these are better seen in other quarries, and will be noticed hereafter.

The rock which forms the upper ten to twenty feet of the face of the pit is of a very different nature from that upon which it rests. These upper beds are stratified—that is, they occur in distinct layers or strata—a fact which shows us at once that they were deposited under water; they are not at all crystalline, but are green and red marls, with a band of sandstone from two to four feet thick. Everywhere they follow the irregular surface of the syenite, in one place filling up a deep hollow in that rock, so as to be perceptibly curved.

This is finely shown in an excellent photograph taken by Messrs. Spencer for my work on the "Geology of Leicester and Rutland."

These upper strata are the Keuper marls and Upper Keuper sandstone, a sub-division of a great series of beds called the Triassic formation. The sandstone band is the same as that which forms the Dane Hills, near Leicester, where it contains teeth and spines of fishes and the covering of a little crustacean (*Estheria minuta*) in appearance like a bivalve shell; probably the Enderby bed would yield similar evidences of life to a diligent worker.

But the most remarkable point in this pit remains yet to be noticed. In an excavation on the right-hand of the entrance, and again at the other extremity of the pit, we see *underlying* the syenite (which has all the appearance of having broken through it) a mass of coarse slaty rock of a dull green or grey colour, extremely tough and traversed by many fine lines or veins, very spotty too in places. The water in the hollows of the pit where this slate is exposed interferes much with a careful examination of it, but it appears to have a northerly inclination or dip; at one point it rises 15 feet above the floor of the pit, under which it certainly extends. This (Lower Enderby) quarry is worked by Mr. Marston, who utilises the upper beds (*Keuper Marls*) or "bearing," by making excellent bricks out of the marly beds.

Entering now Enderby village, we find it indeed to be "founded on a rock." When we reach the top of the sharply sloping street we find more quarries, worked by Mr. Rawson. In these the mode of weathering of the syenite is well shown: the surface blocks have become rounded into immense balls varying from 1 to 8 feet in diameter, and these are often surrounded by coat after coat of rock which scales off under blows of the hammer.

2. *Narborough.*—We now retrace our steps, and passing by Narborough village cross the famous old Roman road called the Fosse Way, which runs straight as a line from this point to High Cross. The road to Huncote diverges here from the Fosse Way, and close to its northern side we have another very large quarry (worked by Messrs. Nowell and Robson) in which syenite is again visible. Those who refer to the Government Geological Map of South Leicestershire will not find this outcrop of igneous rock marked upon it. It was either missed by the geological surveyor or was then covered over by Keuper Marl and soil. The stone is of a much redder tint and is more compact than that of Enderby, but is of the same general nature.

3. *Croft Hill.*—This hill is of a beautifully conical form and is a marked feature in the scenery of the district. Its height is about 580 feet above the sea, and 300 feet above the surrounding plain. It has been attacked on two sides, a large quarry being worked on the north-east flank close to Huncote village, while very extensive workings have of late years been opened in the south-east corner, near the village of Croft.

Proceeding from Narborough we walk through Huncote village and enter Mr. Marston's fine quarry. This is now in good working order; the floor of the pit is level, of great extent, and about 80 feet below the surface. The stone is wheeled in trucks along tramways laid on the floor of the pit, and is then raised to the surface by a novel and effective lift; it is of excellent quality.

Walking towards Croft along the side of the hill we pass several openings or "trial-holes" which have been made to prove the quality of the rock. We note here that the rock has a speckled appearance; the white spots are due to the partial decomposition of some of the felspar crystals.

The quarries near Croft village are very large and have been ably developed by the manager, Mr. Pochin. Here again we see the Keuper red marls and sandstone resting upon the syenite, from which they slope rapidly away in all directions. Embedded in the lowest stratum of the Keuper are many large masses of syenite; this is splendidly seen in a deep cutting made for the laden stone-trucks to pass out of the pit. On the sides of this quarry too we see above the red marls in one place a fine exposure of the *drift.* This is the term applied to the accumulations formed during the last glacial period, when these islands were covered by ice, which, gathering together to form glaciers, pushed over the surface, breaking up and carrying forward the surface rocks. The drift-beds here seen are grey or brown clays full of angular masses of rock, many of which, such as the flints, pebbles of chalk, limestone, &c., must have come from a considerable distance.

Next ascending to the hill-top we admire the magnificent view obtainable over the whole of this part of Leicestershire. Due north lie the Charnwood Hills; on the north-east the picturesque village of Enderby occupies high ground, hiding Leicester from our view, but we can see the white stone spire of St. Peter's Church on the Spinney Hills gleaming on the right. The low eminence close at hand on the west is Barrow Hill, which we must visit, and southward we note the long ridge on which stand the villages of Stoney Stanton and Sapcote. Croft Station lies at the foot of the hill, providing the means of a speedy return to Leicester, and as we cross the Soar we note the rocky and picturesque gorge through which the river flows, this being the only point at which any syenite is found on the east or right bank of the Soar.

4. *Sapcote and Stoney Stanton.*—Getting out at Croft Station we turn to the left and then take an old bridle-road which leads across the fields on the right hand. Soon we reach Sopewell Bridge, an old and interesting bit of masonry; then bearing to the left we cross the water-meadows, and ascend the slope which clearly marks to the geological eye the presence of a different and harder kind of rock. We are now close to the village of Sapcote, and here is Sopewell Quarry, the property of Messrs. T. and J. Spencer, but leased and worked by Mr. Marston. This pit has been opened and developed entirely within the last nine years. When the surface soil was removed, the syenite on one side was seen to be covered by 8 or 10 feet of sand, above which came a number of coarse boulders from 6 to 18 inches in diameter. The whole had the appearance of an ancient sea-beach, and the polished condition of the surfaces of the syenite may have been due to the friction of the sand. My best thanks are due to Messrs. T. and J. Spencer for the fine photograph of this old sea-cliff, taken especially for my work on the "Geology" of the county. Under the adjoining cottages called Granite-thorpe there exists some blackish boulder clay, which was excavated in digging a reservoir for water. The stone of Sopewell Quarry is a tough syenite of excellent quality. Here I found some good crystals of iron pyrites, a mineral of a shining yellow colour, common enough at Mountsorrel, but which I have not found elsewhere in these South Leicester-shire pits; epidote too occurs, and may be known by its apple-green tint, and there are some large crystals of pink

felspar. The height of the edge of this quarry I found by aneroid to be 320 feet above the sea.

Making now towards the windmill, some shallow excavations, the "Parish pits," are seen by the roadside. A little further on, on the left-hand side of the road, is "Lovett's Pit," leased by Mr. Marston; it is almost full of water, but we note that some of the stone has a strong reddish tint. Crossing a field on the opposite side of the road (in which many Roman relics have been found), Cauver Hill Quarry lies at our feet. "Cauver Hole" would be a better name for the spot, for the little knoll has been quarried away, and the workings are now some 20 feet below the surface. Here we noticed a remarkable rounded mass of coarsely crystalline felspar (red) and quartz, which had been found enclosed in the syenite.

Cauver Hill contains the "syenite nearest to London;" it is the most southerly exposure of these old rocks. Retracing now our steps, we pass through Sapcote village, and proceed towards Stoney Stanton. As we near the latter village we find an extensive opening called "Stanton Top Pit," on the right-hand side of the road. It is separated from Stanton village by a narrow but rather deep valley. Stanton itself is mostly founded on the bare rock—a circumstance which, from the value of the stone, may very likely in time to come lead to a removal of at all events some of the houses. An observation with the aneroid showed the top of the "Parish Pit" to be 330 feet above the sea. Here there are four openings or pits:—(1) Wood's Pit, immediately adjoining the roadside, and of very limited area; (2) the Parish Pit, lately purchased by the Mountsorrel Granite Company—(these two pits stand on a little eminence called Carey Hill); (3) Stanton Bottom Pit (or Clent Hill Pit), where red marl is again seen, overlying the syenite; and (4) Varnam's Pit, at the back of the Blue Bell Inn.

From Stoney Stanton we can return either to Elmesthorpe or Croft Station, each being less than two miles distant.

5. *Barrow Hill.*—This point lies about the same distance on the north side of the railway from either of the two stations we have just mentioned that Stoney Stanton does on the south side, and is one and a quarter mile south-east of the village of Earl Shilton. A farmhouse and a windmill stand on the low rise of ground, which hardly deserves the name of hill. The highest point I found by aneroid to be 395 feet above sea-level. The rock is exposed in numerous shallow deserted workings near the mill, and again in a "parish pit" a little further east. The colour of the stone varies from a light grey to a decided pink.

(*To be continued.*)

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(Continued from vol. VI., page 258.)

LABIATÆ.

LYCOPUS.

L. europæus, *Linn.* *Gipsy Wort.*
Native: In damp woods and ditches. Locally abundant. July, August.
I. Sutton Park; Middleton Heath; Coleshill Pool; Meriden Marsh; Balsall Street; Hampton-in-Arden; Knowle; Solihull; Shelly, etc.
II. Honington, *Newb.;* by the canal near Rugby, *Blox.*, *N. B. G. S.;* canal near Stratford; Henley-in-Arden; Sowe village.

MENTHA.

M. rotundifolia, *Linn.* *Round-leaved Mint.*
Denizen: In damp or marshy pastures. Very rare. August.
I. Abundant in a swampy field near Boldmir, Sutton.

M. alopecuroides, *Hull.* *Horse Mint.*
Denizen: Near villages. Very rare.
II. In the old moat near Chesterton Church, in abundance for two years, but now probably extinct, *H. B.*

M. sylvestris, *Linn.* *Horse Mint.*
Native: In marshy and watery places. Very rare. August, September.
II. Great Alne, on the side of the ford leading to Haslor, *Purt.* iii., 53.
b. nemorosa. Very rare.
II. Near Sunrising, Edge Hills, *Bolton King.*
[*M. viridis*, Linn., has been recorded from near Bilton, Rugby, 1833, but no later record is known to me.]

M. piperita, *Huds.* *Peppermint.*
Denizen: In damp places, by ditches, streams, and canals. Rather rare. August, September.
a. officinalis, Hull.
I. River at Tamworth, *With.*, ed. 5, iii., 612; near Middleton Park, abundant, 1872; Four Ashes, near Solihull; Hockley, near Solihull.
II. Coughton Mill, side of the River Alne, *Purt.* i., 276; Myton, *H. B.;* Honington; Spernal Ash; Lapworth; Kingswood.
b. vulgaris, Sole.
I. Four Ashes, near Solihull.
II. Warwick, *Y. and B.;* Balsall Common, *H. B.; Herb. Bab.*

M. hirsuta, *Linn.* *Hairy Water Mint.*
Native: In marshes, by rivers, streams, etc. Common. August, September. Area general.
b. subglabra, Baker.

I. Stockingford; Packwood.
II. Spernal Ash; Lapworth; Broad Lane, near Berkswell; a slight variety occurring at intervals with type.

M. sativa, *Linn.* *Marsh Whorled Mint.*
Native: In damp woods, marshes, ditches, &c. Local. August, September.
a. rivalis = *genuina.*
I. Sutton Park, (casual); Trickley; Bentley Park (small form); Arley; Coleshill Pool; Marston Green; Hampton-in-Arden; Shelly; Monkspath.
II. Emscote, *Y. and B.*; pit near Rounsel Lane, *H. B.*; Honily, *H. B.*, *Exch. Club Report*, 1879, labelled *paludosa*; Broad Lane, Berkswell.
b. paludosa, Sole. Rare.
I. Sharman's Cross; Monkspath; Shelly, near Solihull; Beardsmore, near Hockley.
II. Ditch near Honily, *H. B.*, *Herb. Bab.*
c. subglabra. Baker. Rare or overlooked.
I. Coleshill Pool; Spring Coppice, near Hockley.
II. Beausale Common! *H. B.*, *Exch. Club Rep.*, 1874.

M. rubra, *Sm.* Tall Red Mint.
Native or denizen: In drains and ditches. Rare.
I. Bannersley Pool; Monkspath, near Hockley (peculiar form), very abundant, 1871.
II. Near Haseley (?) *H. B.*; Offchurch, *Y. and B.*; ditch near Luddington; Withybrook, near Nuneaton; Sowe waste canal. The plant from Luddington, which appears to be similar to the form "gathered by Dr. Windsor, at Partington, Cheshire, has long white fleecy hairs upon the teeth and upper part of calyx, and the stem and veins of the under side of the leaves are similarly clothed." *See* Baker "On English Mints," page 17.

M. gracilis, *Sm.* *Slender Red Mint.*
Native: In watery places. Very rare. August.
II. Ted Pit, Allesley, *Bree, Purt.* iii., 54.
b. cardiaca, Baker. Very rare.
II. Haseley Common, *H. B.!* *Exch. Club Rep.*, 1876; Shrewley Common, *Dr. Baker*, *Exch. Club Rep.*, 1877-8.

M. gentilis, *Linn.* *Bushy Red Mint.*
Native: In watery places and river sides. Rare. July.
I. What may be this at Marston Green and Four Ashes.
II. Side of the River Alne; Oversley, near the bridge, *Purt.* i., 276. Fillongley, *Kirk*; Haseley, *H. B.*
b. Wirtgeniana. Very rare.
II. Chadshunt, *Bolton King.*

M. arvensis, *Linn.* *Corn Mint.*
Native: In fields, pastures, and waysides. Locally common. June to September. Area general.
b. nummularia, Schreb. Rare.
I. Fields near Knowle.
c. agrestis.
II. Fillongley, *T. Kirk*; Bradnocks Marsh, Hampton-in-Arden; *R. Rogers*; Austey wood, near Henley-in-Arden.
The varieties in this species do not appear to be of a very marked character.

M. Pulegium, *Linn.* *Pennyroyal.*
Denizen: Damp places on heath lands. Very rare. August, September.
I. Side of a pool at Edgbaston, *With.*, ed. 7., iii., 706.
II. Half dry pits, Allesley, *Bree*, *Purt.*, iii., 52; Corley Moor, *T. Kirk.* I do not think it would be found in any of these stations now.

THYMUS.

T. Serpyllum, *Linn.* *Creeping Wild Thyme.*
Native: On heaths, heathy waysides, and dry banks. Locally common. July to September.
I. Sutton Park; Middleton Heath; Coleshill Heath; Cornel's End, etc.
II. Salford Priors! *Rev. J. C.;* Tredington; Honington, *Newb.;* high ground near Billesley Hall; Bardon Hill; near Kineton.

T. Chamædrys, *Fries.* *Larger Wild Thyme.*
Native: On marly banks and in pastures. Very rare. July to September.
I. Sandy Field, above Coleshill Pool.
II. Hatton, *H. B.*, *Herb. Perry;* between Wroxall and Rowington, *H. B.;* Yarningale Common, *H.B.*, *Herb. Brit. Mus.;* fields between Harborough and Cosford, *Rev. A. Blox.;* banks between Kineton and Compton Verney; near Billesley Hall; banks near Crab Mill, Preston Bagot.
Var. *alba*, near Ufton, Southam, *Bolton King.*

ORIGANUM.

O. vulgare, *Linn.* *Common Marjoram.*
Native: On railway banks, and banks in calcareous soils. Very rare. July, August.
II. Salford Priors, *Rev. J. C.;* Steeple Hill, near Bidford; possibly an escape. Railway cutting near Coventry station, doubtfully wild.

CALAMINTHA.

C. Clinopodium, *Spenn.* *Wild Basil.*
Native: On dry banks and waysides. Local. July, August.
I. Tamworth road, near Sutton; Elmdon; lanes about Solihull; Hay Lane, near Hockley; lanes about Hampton-in-Arden and Bickenhill.
II. Lambcote, *Newb.;* Gaydon, *Bolton King;* Kineton; Myton; Shotwell; Alveston pastures; Bidford; Wixford; Exhall; Alcester; Arrow Lane.

C. Acinos, *Clairv.* *Basil Thyme.*
Native or colonist: On heath lands and pastures. Rare. July to September.
I. Sutton Park; footways near Coleshill Pool; sandy pastures, Coleshill Heath.
II. Grafton and near Rolls Wood fields, *Purt.* i., 281; between Milverton and Ashow, *Perry*, 1817; near Wilmcote, on the footway to Billesley! *Cheshire*, *Herb. Perry;* Moreton Morrell, *H. B.*

C. menthifolia, *Host.* *Common Calamint.*
Native: On dry hedge banks. Rather rare. June to September.

I. (*Thymus Calamintha*), near Tamworth Castle, *With.*, ed. 7, iii., 723. Dry banks, lane from Shustoke to Maxtoke.

II. (*Melissa Calamintha*), Pophills Lane, Wixford! *Purt.* i., 285. (*Thymus Calamintha*), Warwick Castle Mount; Hatton! Abbots Salford! near Leamington! *Perry, Fl.*, 54; near Wasperton, *Herb. Perry!* near Stratford-on-Avon, *Herb. Perry!* Charlcote, *Bolton King;* Alveston pastures; Arrow; Myton.

b. Briggsii (Syme), *c. ascendens* (Jord.) Very rare.
Hatton, *H. B.*, *Exch. Club Rep.*, 1879; near Wixford; Myton.

A slight variety merging into type.

[*Melissa officinalis*, Linn. *Common Balm.* Occurs as a casual weed of short duration, occasionally, as at Radford Semele and the Woodloes, *H. B.;* a mere escape.]

NEPETA.

N. Cataria, *Linn.* *Catmint.*
Native: In pastures and on dry banks. Rare. July, August.

I. Dry banks near Great Packington.

II. Oversley, on hedge banks by Mr. Edkin's farm, *Purt.* i., 279; near Stratford, on the Warwick Road; roadside between Warwick and Myton! *Perry, Fl.;* between Stratford and Warwick, *Blox., M.S. note;* near Whitley Common, *Herb. Perry;* on the Fosseway, near Lambcote; near Halford, *Newb.;* Moreton Morrell, *Y. and B.;* near Alveston; *F. Townsend;* Bardon Hill; Binton; near Atherstone-on-Stour; abundant, Loxley Road, near Stratford.

N. Glechoma, *Benth.* *Ground Ivy.*
Native: On banks, waysides, in woods and pastures. Common. April to June. Area general.

b. parviflora, Benth. Rare.

I. Hampton-in-Arden; Furnace End near Shustoke.

II. Banks of the Leamington Canal, *H. B.; Exch. Club Rep.*, 1879.

c. hirsuta. Rare.

I. Dry bank near Hampton-in-Arden.

II. Kenilworth, etc., *Y. and B.;* near Claverdon.

SALVIA.

S. Verbenaca, *Linn.* *Wild English Clary.*
Native: On dry banks and waysides, and in churchyards. Rare. June to October.

I. On the Castle Hill, Tamworth, *With.*, ed. 7, ii., 26.

II. Bidford! and Haslor, near the churches, *Purt.* i., 57; Pigwell Lane, Warwick, 1812; Stratford churchyard! *Perry, Fl.*, 3; Warwick Park, *Y. and B.;* Salford Priors, *Rev. J. C.;* Binton churchyard, 1878; Ashorne; Bidford churchyard.

S. pratensis, *Linn.* *Meadow Sage or Clary.*
Denizen: In old pastures. Very rare. July.

II. Dry fields east of Kineton, *Bolton King, Ex. Herb. Brit. Mus.;* Chadshunt, *Bolton King!*

(To be continued.)

NIAGARA AND ITS WILD FLOWERS.

A lovely afternoon in the Indian summer! We are sitting near the top of the hill close above the great Horse-shoe Fall at Niagara, and the wealth and loveliness of the wild flowers, forming one of Nature's most exquisite wild gardens, lying stretched out at our feet, makes us think how many of our gardening friends would find a deep enjoyment could they be here, and see what we are now seeing, and what I will try to describe, faint and feeble though my description must necessarily be in comparison with the glorious reality. The great cataract itself is of unusual magnificence. The early autumn rains have brought a large body of water into the lake, and the torrent of liquid emerald pouring over the jagged rocks is deep and massive, and its thunder has an unwonted tone of grandeur and solemnity. Far away in the distance lie the quiet waters of the great lake, placid and unstirred as yet, and the white sail of a far-off boat is seen as it gets an occasional gleam of sun while passing from one shore of the lake to the other. Nearer at hand, for the space of a mile or so before reaching their doom, the waters, placid no longer, foam and swirl, hurrying madly along. Every dancing wave-crest is turned into molten silver in the rays of the westering sun; every rock lying in the channel seizes a passing wave and whirls it upwards in masses of glittering spray, till at last, when on the brink of the great chasm, there comes to the rushing waters a sudden gathering up of irresistible strength, and they, whose only object hitherto seems to have been to dash themselves past all obstacles with reckless and ever-increasing speed, became all at once possessed with a sense of their awful power as they suddenly, swiftly, silently, drop over the perpendicular rock into the fearsome turmoil below, great green jewels, wide and deep, in a setting of frosted silver.

And this solemn magnificence and grandeur has the exquisite contrast of so lovely and peaceful a foreground. The hillside, down which we are looking, and which stretches to the edge of the water, is aglow with vivid colour—huge golden masses of Solidago of many kinds, great clumps many yards wide of big, deep purple, primrose-eyed asters, alternate with those of a pale shimmering lilac, and with others, small flowered but profuse in bloom, while throughout the undergrowth is a bright blue gleam, as though some spangles had fallen from the sky—the gift of a flower of which the name is unknown to me. Then from out the grass shine everywhere small bright flowers of many colours, among them a delicate gentian-like bloom bravely lifting up its head on a slender stalk. And there are many lovely flowers besides—a bush covered with apricot-coloured blossoms in shape like a Mimulus, a glowing mass of red Lythrum, and a delicately lovely aster, in which the lilac is replaced by a sheeny-grey pink. The feathery blooms of Spiræa and some white daisies shine here and there among their more richly-coloured sisters. It is indeed a garden unapproachable in its own beauty, and with its tender loveliness made more impressive by its wonderful surroundings. Just where we are sitting we have taken advantage of masses of tall shrubs and the stems of forest trees, to shut out from view all buildings and roads, and have left ourselves with the Falls and the Nature-planted garden as they might have been seen long, long ago. There is hardly a breath of wind; the great misty columns of spray rise high into the sky from the base of the falling water, and it is only at rare intervals that a wandering spirit of air takes one of the lighter spray clouds and bends it over towards us, when its soft and dew-like mist is shed over the thirsty flowers, making their vivid colours glow with intenser beauty in the rays of the setting sun. As the gentle breeze passes by they bow their heads in gratitude for the welcome moisture, and a rustling murmur runs from top to bottom of the hill as they raise themselves up again in thankful praise. And ever the voices of the waters are circling around us, now seeming to raise a threatening warning of their irresistible power, now chanting a solemn death song as they are hurled over the precipice to be broken to the very last drop into foam, and spray, and mist on the rocks below, and ever through the voices, now loud, now low, with unceasing iteration, seems to vibrate a note of praise to the great Creator of all for the use He has made of them in the formation of one of the wonderful sights He has given on earth for our enjoyment.

And now, with sudden dip, the sun is lost behind the hill; the air strikes chill, and the flowers begin folding themselves away to sleep, but the beauty of the scene entrances us yet. In front of the now dark and sunless foreground sweeps the broad horse-shoe of foaming and struggling water; the great emerald is now changing into myriad-tinted opal; the wavelets that leap into the air all along the whirling rapids are dyed with a flush of pink; while from far down in the gloom and depths of the Great Fall a rainbow rises into the misty mass of spray. Above, around, and through the spray gleam the floating clouds in the evening sky—now blushing o'er with rosy flame, now slowly changing to a lustrous gold, till all colour slowly fading gleam by gleam away, the grey hush of the coming night falls over the wondrous scene. As we rise to begin our way down the hill, our first step seems to bring us back from a world of dreams, and we know afterwards that the same thought was in both our minds and the same words were ringing in both our ears, those words in which God gives us a fore-shadowing of His eternal mysteries:—"Eye hath not seen, nor ear heard, neither have entered into the heart of man, the things which God hath prepared for them that love Him."—From "The Garden," by H. Stuart Wortley (Colonel).

HYBRID MOSS.—H. Philibert records a new instance of a hybrid moss, found wild, between *Orthotrichum diaphanum* and *O. sprucei*. He considers it a true instance of a hybrid sporogonium, resulting from the fertilisation of an archegonium of *O. sprucei* by antherozoids of *O. diaphanum*. The hybrid was intermediate in its characters between the two parents, and also in the time of producing its reproductive organs.—Rev. Bryol, X., p. 813 (1883).

DARWIN'S ESSAY ON INSTINCT.

This so-called "posthumous" essay of the late Charles Darwin, which was written thirty years ago, was read at a recent meeting of the Linnæan Society by Mr. G. J. Romanes, to whose forthcoming work on the "Mental Evolution of Animals" it will be added as an appendix. The following is an outline of the paper:—Under the head of *migration* the main points with which Darwin is concerned are—(1) that in different kinds of birds we can trace a perfect gradation from those which, with more or less regularity, change their quarters within the same country, to those which at regular intervals migrate to another country; (2) the same species is found in one country to migrate, and in another not to do so, or migratory and stationary individuals of one species may be found in the same country; (3) the migratory instinct may be resolved into two distinct factors—a periodical *impulse* to travel, and a *sense of the direction* in which to travel; (4) men in a savage state are known to exhibit a sense of direction, lost in more civilised individuals, which may be analogous to that shown by animals; (5) certain birds and animals have truly migratory instincts. On these admitted data Mr. Darwin proceeds to found his theory of the origin of the migratory instinct. This theory is, that the ancestors of migratory animals were annually driven, by cold or want of food, to travel slowly southwards, and that in time this compulsory travelling would become an instinctive passion, as in the case of certain Spanish sheep. In the case of birds, the wings would be used, and if in the course of many generations the land over which they were in the habit of flying in their annual journey were to be slowly submerged, the line of flight would tend to remain unaltered, and we should thus arrive at the state of things which we know now to exist, viz., migratory birds flying over great stretches of ocean.

In regard to another kind of instinct, we are in possession of abundant facts to show that, in the case of man, instinctive *fear* does not exist in a state of nature; it has first to be acquired, and is then lost again under domestication. The feigning of death by insects and spiders is shown to be merely an instinct of remaining motionless, and therefore inconspicuous in the presence of danger, there being no idea of *death*, or the simulation thereof, on the part of the animal.

In respect of a third instinct, that of *nest-building*, many facts show that it is subject to great variation, both in an individual and, in course of time, in a species. Hence Darwin argues—"If it be admitted that the nests of each bird, wherever placed, and however constructed, be good for that species under its own conditions of life, and if the nesting instinct varies ever so little when a bird is placed under new conditions, and if these variations can be inherited, of which there can be little doubt, then natural selection in the course of ages might modify and perfect almost to any degree the nest of a bird in comparison with that of its progenitors." Mr. Darwin shows likewise that variations of instinct have occurred in animals, as, *e.g.*, the hyæna of South Africa has ceased to make burrows, and so on; and similarly the lodge of the beaver might have been developed out of such a habitation as is made by the musk rat. The author continues—"As there is often much difficulty in imagining how an instinct could first have arisen, it may be worth while to give a few, out of many, cases of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, give rise to such." After doing this, Mr. Darwin proceeds to consider some of the special difficulties of the subject from the point of view of natural selection, and finally sums up the argument in his usual way. His concluding words are—"It may not be logical, but to my mind it is far more satisfactory, to look at the young cuckoo ejecting its foster-brothers, ants making slaves, the larvæ of the Ichneumonidæ feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies—Multiply, Vary, let the Strongest Live and the Weakest Die."

Though this doctrine may not be in accord with our usual lines of thought, there can be no doubt that it is at once more logical (in spite of Darwin's hesitation to make the claim in the sentence just quoted), and more reverent to the Creator, to suppose these things to be but minute details of one general plan, gradually working itself out in the course in which He has set it, than to picture each detail as independently fixed and considered, where, as often happens, the instinct only leads to its possessor's misery or death. It may be added that, as may be gathered from what was said at first, this essay must not be regarded entirely as giving the views of its author as he would have set them forth, had he elaborated the subject with all the wealth of his later knowledge.—W. B. G.

In another paragraph we have referred to the retirement of Professor Owen from his active duties. Still another veteran has signified that he is probably approaching the end of his long scientific labours. In the last number of the "Annals and Magazine of Natural History" the Rev. M. J. Berkeley, in a concluding note to his contribution to "British Fungi," says that he is "glad to be able to make" a certain correction, "as this is in all probability the last of a long series of contributions." How long they have been our readers may form some idea, if we state that they commenced in 1837, in the "Magazine of Zoology and Botany," and that Mr. Berkeley has enumerated in them over 2,000 species of Fungi new to our British Flora.

Reviews.

Half-hours with the Stars. Twelve Maps of the Constellations, with descriptions. By R. A. Proctor. Fourteenth thousand. Price 2s. 6d.
Half-hours with the Telescope. By R. A. Proctor. 109 pp., 7 plates, 15 woodcuts. Price 2s. 6d. Eighth edition. W. H. Allen and Co., Waterloo Place, London.

These are new editions of two well-known books, now issued by Messrs. Allen and Co. The celestial objects described in the book on the telescope are all within range of a small instrument, and are described with Mr. Proctor's well-known lucidity. The introductory chapter on the "structure of the telescope" is very good indeed, and supplies just the information required by amateurs.

The *Star Maps* form a capital companion to the telescope; but even without any instrument they enable any person to become acquainted with the "star-lit sky." Their use will obviate Carlyle's complaint, "Oh, why did not some one teach me the stars and the constellations when I was a boy!" The maps hold true for every year, and are so arranged that they can be consulted on any given hour of any night. They are very distinctly printed in white on a dark-blue ground.

Land and Freshwater Shells of the British Isles. By R. Rimmer, F.L.S. 8vo. 205 pp., 10 plates. Price 6s. Published by W. H. Allen and Co., London.

The study of shells is, perhaps, the best which can be taken up, as an introduction to Natural History, by anyone desirous of commencing practical work. Shells are to be found everywhere, and at all seasons of the year. They are usually of sufficient size to enable their characters to be distinguished by the naked eye, and their preservation involves no difficulty. To the geologist, too, the study of living shells is of great importance; for he must not expect to understand the (frequently fragmentary) fossil shells which are so common in rocks, unless he has first formed some acquaintance with their living representatives.

For the study of our British land and freshwater shells only one thing was wanting, and that has been supplied by the publication of Mr. Rimmer's clear, yet thoroughly scientific and carefully prepared hand-book, which includes excellent figures (reproduced by the Albertype process from photographs) of all the British species. The introduction contains very useful hints about collecting, and the preparation and care of the specimens when once obtained; while in the body of the work the descriptions of specific characters are full and accurate. Ample and interesting information is also given as to localities, habits, etc. The most recent researches of British conchologists are here referred to, among which we notice frequent mention of our able contributors, Messrs. G. Sherriff Tye and W. G. Blatch.

Flowers and their Pedigrees. By GRANT ALLEN. 266 pp., 54 cuts. Price 7s. 6d. Longmans, Green, and Co.

THIS attractively printed and well-bound volume contains an article upon the "Daisy's Pedigree," in which Mr. Allen claims a very high position in the vegetable world for the "wee, modest, crimson-tippit flower," arguing that, "from the strict biological point of view, daisies really stand to other plants in the same relation as man stands towards other animals." In the next article, "The Romance of a Wayside Weed," the history of that rare plant, the hairy wood-spurge, is discussed, and it is shown to be a relic of that Mediterranean flora which, before the last glacial epoch, stretched at least as far as our south-western counties. Then we are told about "Strawberries," and here, in one paragraph, Mr. Allen has so well described an instance of "evolution" that we quote his words in full:—"A strawberry, as we all know, consists of a swollen red receptacle or end of the flower-stalk, dotted over with little seed-like nuts, which answer to the tiny dry fruits of the 'barren strawberry,' or potentilla. Suppose any ancestral potentilla ever to have shown any marked tendency towards fleshiness in the berry, what would happen? It would probably be eaten by small hedgerow birds, who would swallow and digest the pulp, but would not digest the seed-like nuts embedded in its midst. Hence the nuts would get carried about from place to place, and dropped by the birds in hedgerows or woods, under circumstances admirably adapted for their proper germination. Supposing this to happen often, the juiciest berries would get most frequently eaten, and so would produce hearty young plants oftener than those among their neighbours which simply trusted to dropping off casually among the herbage. Again, the birds like sweetness as well as pulpiness, and those berries which grow most full of sugary juices would be most likely to attract their attention. Once more, the brightest-coloured fruits would be most easily seen among the tall foliage of the hedgerows, and so those berries which showed any tendency towards redness of flesh would be sure to gain a point in attractiveness over their greener rivals. Thus, at last, the strawberry has grown into the fruit that we know so well by constant unconscious selection of the little hedgerow birds, exerted at once in favour of the pulpiest, the sweetest, and the ruddiest berries."

Other valuable essays upon "Cleavers," "The Origin of Wheat," "A Mountain Tulip" (*Lloydia serotina* of the Welsh hills), "A Family History" (in which the origin and development of the existing English roses are considered), and "Cuckoo-Pint," make up a volume which is a valuable contribution to a work which we trust Mr. Grant Allen will continue to carry out—"A Functional Companion to the British Flora." To quote the author's own words, "We know by this time pretty well what our English wild-flowers are like: we want to know next why they are just what they are, and how they came to be so."

Natural History Notes.

THE EXTRAORDINARY SUNSETS AND SUNRISES.—These were observed at Naples and all over Italy during the week ending Dec. 8th, and Father Denza, a meteorologist connected with the Observatory of Montcalieri, attempts to show that they are merely intensifications of a phenomenon not rare in mountainous or more southern regions. He recalls the fact that on the evenings from the 24th to the 26th of September, 1831, throughout Southern Europe, from Madrid to Odessa, the sky at sunset appeared of a deep orange colour and then vivid red; and then says that these phenomena can be explained by the (hygrometric and barometric) state of the atmosphere. But he was evidently unaware, at the time, of the great extent of the earth's surface over which these appearances have been visible, which puts such explanations and the references which have also been made to the *aurora borealis* and the zodiacal light altogether out of the question. The same phenomena were observed in Switzerland shortly after their appearance in Italy. It would be interesting to know if any previous similar sunset displays could be connected with volcanic outbursts.

VOLCANIC DUST, IN RELATION TO THE RECENT SUNSETS AND SUNRISES. —A few further hints and suggestions as to the dependence of the recent wonderful sunrise and sunset phenomena on the presence of volcanic dust in the higher regions of the atmosphere have appeared in the *Times* newspaper lately, from various sources, which it may be worth while to collect together. Mr. Preece points out (Dec. 13) that the electrical state of the particles of dust ejected by a volcano must have an important influence on their distribution in the atmosphere. They must necessarily have at the moment of eruption electricity of the same sign as that of the earth, and therefore must be repelled by it, in opposition to the force of gravity, when the explosive impulse is expended, and thus their suspension in the air be immensely facilitated. In the second place, being all electrified with the same sign, their mutual repulsion must determine the extension in all directions of the cloud formed by them. This is supplemented by Mr. Crookes (Dec. 18), who recalls the fact that he showed in 1879, by the length of time during which two gold leaves repelled each other, that air, at a rarefaction of one millionth of an atmosphere (corresponding to a height of about 62 miles above the earth's surface), is an almost perfect non-conductor of electricity, so that there is every reason to believe that the dust once projected in an electrified state to 50 or 60 miles from the surface would retain its charge almost indefinitely. Colonel Stuart Wortley calls attention (Dec. 18) to the circumstance that there are well-defined belts of the globe where such magnificent aerial effects are very common, and suggests that this may be due to the almost constant ejections from the great South American volcanoes. He mentions also the exceptional sunsets seen at Naples in 1862, during the eruption of Vesuvius in that year.—T. H. WALLER, B.A., B.Sc.

THE BLUE MOON; GREEN SUN; AND GORGEOUS SUNSETS.—On December 4th, at 4.30 p.m., I saw the crescent moon of a distinctly greenish-blue colour—electric blue my wife designated the tint; the phenomenon only lasted for about a quarter of an hour. The setting sun was concealed by stratus clouds of a coppery-red hue, while elsewhere masses of cumulus were separated by patches of blue sky. This "blue moon" was seen at several other places in England on the same evening, according to notices which have appeared in "Nature," "Knowledge," etc. Throughout this country generally, during the latter part of November and the beginning of December, the sunsets have been grand beyond description, and a rosy glow has hovered over the western sky for more than an hour after the sun's disappearance below the horizon. From India and from the Soudan accounts of an abnormal greenish disc presented by the sun during the last few weeks have been received. How are these unusual meteorological phenomena to be accounted for? Two theories have been advanced. Mr. Mathieu Williams found the snow which fell early in December to be full of particles of the magnetic oxide of iron, and he considers it possible that these were derived from a cloud of cosmic dust through which the earth has lately passed, or rather which has been attracted to the earth by the force of gravitation. Other scientists attribute the presence of this matter in the atmosphere to the terrible volcanic outbursts which have lately occurred in the East Indian archipelago. Enormous quantities of finely-divided matter have there been shot up to a great height from volcanic craters, and this matter, carried by air-currents, has gradually spread westward, until, at last, it has even invaded the skies of Britain. Each theory, it will be noticed, explains the phenomena actually observed by referring them to the action, upon sun-light, of finely divided matter in our atmosphere, and in this each is no doubt correct. It is not the sun which has varied in colour, but certain of the sun's rays have been absorbed while passing through the air—the red rays chiefly—and therefore the sun appears green. So, also, the moon—which we see by reflected sun-light—has had a bluish tint instead of her usual silvery-white hue. The proverb, "not once in a blue moon!" and the historical statement that "the moon is made of green cheese!" would seem to have their origin in previous observations of a similar nature. By searching the meteorological (and other) records of the past, it may be possible to ascertain if any similar change of colour has accompanied former great volcanic outbursts.—W. JEROME HARRISON.

FERTILISATION OF THE BORAGINACEÆ.—The change of colour in various boraginaceous flowers would seem to bear relation to their fertilisation by insects. Hermann Müller remarks that he has observed that insects visit exclusively those which are red or just beginning to change to blue. All the blue flowers which he examined in a locality about 2 yards broad and 20 long, where many hundred flowers of Pulmonaria were in all stages of development, proved to be empty of honey, and all which he observed with the aid of a lens had the stigma already supplied with pollen; so that it would appear that, as in Lantana and *Ribes aureum*, the change of tint serves as a guide to insects visiting the flower. This is a subject to which the attention of Midland botanists could be easily directed and with good results, for we have several genera of Boragineæ, such as Echium, in which we could observe the change; and it would be worth while also to consider it in relation to Grant Allen's theory of the "Colours of Flowers," according to which the blue colour is developed for the attraction of certain kinds of insects, and not as a beacon to warn them that the flower is no longer worth visiting.—See Journ. Roy. Micr. Soc., 1883, p. 864.

Mounting Hydrozoa, Polyzoa, etc., with Extended Tentacles.—Mr. A. D. Michael prefers to use spirits for killing the animals, as osmic acid stains too much. They should be got in good condition, placed in a watch-glass, and syringed freely, and then placed under a low power and watched until the tentacles are well extended. Then with a fine pipette run a small drop of spirit down the *side* of the glass, not on the polype. The creature will probably withdraw its tentacles. If so, leave it alone until they expand again; without disturbing it run another drop down the glass. After doing this once or twice the animal gets dull and heavy, drunk in fact, and then spirit may be added freely, and the polype mounted. As a medium for mounting, spirit and water give very good results, possibly the best on the whole; but Goadby's solution preserves the creatures in more natural form, and keeps the sarcode harder, presenting a more life-like appearance, but it is open to the objection that it contains corrosive sublimate, which produces a certain amount of discoloration of the creature after a time. Another objection is that it has a tendency to cast a sediment. For that reason it should be used weaker than the book strength, adding about three times the quantity of water.—Journ. Quek. Micr. Club, I., p. 241 (1883). [Would not these be better mounted in pure spirit, like the *Leptodora hyalina* mounted by Mr. Clarke? See "Midland Naturalist," 1883, p. 282.]

"The Wild Garden."—"As far as my eye can range it rests only on flowers—on beautiful flowers! I am looking as on a tinted map—an enamelled picture brilliant with every hue of the prism. Yonder is golden yellow, where the Helianthus turns her dial-like face to the sun; yonder scarlet, where the Malva rears its red banner. Here is a parterre of the purple Monarda; there the Euphorbia sheds its silver leaf. Yonder the orange predominates in the showy flower of the Asclepias, and beyond the eye roams over the pink blossoms of the Cleome. The breeze stirs them; millions of corollas are waving their gaudy standards. The tall stalks of the Helianthus bend and rise in long undulations like the amber waves of a cornfield, like billows on a golden sea."—W. Robinson, F.L.S.

SAFETY STAGE FOR THE MICROSCOPE.—At the meeting of the Royal Microscopical Society on November 14th, Mr. Stewart exhibited a safety stage which he had invented, chiefly to meet the want which is sometimes felt in exhibiting a perhaps valuable slide to a class of students, or other inexperienced persons, who are very apt to break the cover-glass by racking the objective down upon it. A piece of wood rather wider than an ordinary glass slide has a hole cut in the centre large enough to admit the light to the object. Between this hole and the sides of the piece of wood two small strips of wood are fixed, and on the top of each of these is a thin strip of brass, rather longer than the strip of wood, so as to overhang at each end. A couple of india-rubber rings are then passed, one round each pair of projecting ends, and between these, suspended in a kind of hammock, is placed the slide which it is desired to protect. If then the objective is brought down upon the cover-glass, the india-rubber springs yield to the pressure, and the object is saved from destruction.

ICE-GROOVED BOULDERS.—The curious phenomenon of ice-grooves passing round the corners of boulders, mentioned by Mr. W. J. Harrison in the December number of the "Midland Naturalist," as having been observed in the basalt boulders of the Rowley Hills by Dr. Crosskey, reminded me of something similar that came under my own notice while rambling on the south coast of the Isle of Man during a holiday visit in the summer of 1875. It was just south of Port St. Mary, where the extremity of a blunted spur of coast is fringed for about half-a-mile with Lower Carboniferous Limestone. At one spot the sea was quietly removing the stiff brown boulder clay that hid the limestone in some places from view. A miniature promontory of limestone, two or three feet in length, that had recently been uncovered by the waves, attracted my attention on account of some ice-scratches that I thought I could detect on it. The little projecting rock rose into a peak or crest down the middle, and the ice-scratches and grooves passed right over the smoothed and polished ridge from one side to the other, or in an east and westerly direction, and parallel with the coast-line, instead of away from it, as one would have expected. How to account for these scratches by the action of floating ice was long a problem to me, for I had not yet learnt that most of these striations on rocks had been produced by the action of land-ice or glaciers. Of course if this rib of polished and scratched limestone came to be torn up and broken into boulders by the action of the waves, some of these boulders would present the curious phenomenon noticed by Dr. Crosskey of striæ passing uninterruptedly across the corners from one face to another. I am glad Mr. Harrison was so thoughtful as to mention the matter in the pages of the "Midland Naturalist," as otherwise I should have heard nothing about it. It seems to me rather a misfortune that such papers are not either distributed more widely among the Societies in the Union or reprinted in this magazine. Such papers as Dr. Crosskey's are of absorbing interest to most geologists.—J. SHIPMAN, Nottingham.

PREPARATIONS OF COAL.—P. F. Reinsch's preparations of coal from the carboniferous strata, the Dyas and Trias (the material being very difficult to reduce to thin and sufficiently transparent sections), are made by using the finest emery employed in polishing mirrors; powdered chalk obtained by levigation, and carbonate of lime precipitated from lime-water by soda are also used. A small piece of cork serves as a rubber. During the process the preparation is moistened with glycerine.—Bull. Soc. Belg. Micr., IX., pp. 87-8 (1883).

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, Nov. 27th.—Mr. T. H. Waller read a report on the Geological Specimens collected by the Society during the Oban excursion. GENERAL MEETING, Dec. 4th.—Mr. T. Clarke exhibited glass microscopic slides, with the etched ring on the surface, as referred to at the previous meetings, by which greater security is obtained for the adhesion of the cement when mounting in cells containing glycerine or other liquids. Mr. J. E. Bagnall exhibited *Ditrichum flexicaule*, from near Bidford; also (for Mr. J. B. Stone) *Racomitrium canescens*, from Norway; *R. lanuginosum*, *Hedwigia ciliata*, *Pterogonium gracile*, and *Eurhynchium myosuroides*, from Barmouth; *Hookeria lucens*, from Malham; also (for Mr. Wm. Mathews) *Galium sylvestre* from Lancashire; *Linaria repens*, *Thymus Chamædrys*, and *Galium uliginosum*, from Clent; and *Linaria minor*, from Knowle. Mr. W. B. Grove exhibited the following Fungi:—*Polyporus obducens*, *Typhula Grevillei*, *Agaricus pyxidatus*, from Harborne; *Russula drimeia*, and *Chondrioderma deplanatum*, from Sutton. Professor W. Hillhouse, of the Mason College, then read the first part of a paper "On the Continuity of Protoplasm," which will appear in a future number. BIOLOGICAL SECTION, December 11th.—Mr. J. E. Bagnall exhibited *Potamogeton Zizii* and *Selinum Carvifolia* and read notes on the same from Mr. Charles Bailey, F.L.S., Manchester; also *Potamogeton lucens* from near Anstey; *Leucojum vernum*, and *Erica ciliaris*, from Dorset; *Plantago arenaria* and other plants, from near Warwick. Mosses:—*Hypnum Kneiffii* and *H. Lindbergii*, *Leucodon sciuroides*, etc., with microscopical preparations, from Bardon Hill; also (for Mrs. Bailey, of Brixham) *Lycopodium clavatum*, *Cladonia pyxidata*, *C. fimbriata*, *C. elegans*. Mr. T. Bolton exhibited *Foliaceus Coregoni*, male and female, a fish parasite from the Royal Aquarium, Westminster, sent by Mr. Carrington, the Naturalist of that Aquarium. Mr. W. R. Hughes exhibited *Mysis Fabricii* (a stomapodous crustacean), the slide prepared be Mr. F. W. Sharpus of London; also on behalf of Mr. F. H. Collins, a slide of eggs of parasite (Ectozoon) from Reeves' Pheasant. Mr. W. H. Wilkinson exhibited a Lichen from Oban, *Ricasolia amplissima*. Mr. W. P. Marshall gave an explanation of the causes of the remarkable sunrises and sunsets which have been observed during the last few weeks, which is printed in this number. MICROSCOPICAL GENERAL MEETING, Dec. 18th.—Mr. W. P. Marshall read a paper on the "Great Kimberley Diamond Mine," which will appear in a future number. Mr. Austin, who has recently returned from Kimberley, then gave an amusing account of the way in which the mine is worked and the difficulties encountered. Sociological Section, December 20th.—The President, Mr. W. R. Hughes, in the chair. The attendance was small, being doubtless reduced by the near approach of Christmas. The elucidation of chapters 5 and 6 of the Principles of Biology was proceeded with by Mr. J. O. W. Barratt, B.Sc. Lond., and illustrated by exhibits showing the approximate proportions of oxygen and water, and of carbonic acid, urea, and water, which might be supposed to be respectively assimilated and got rid of by a simple organism such as an amœba. *Hydra fusca* was also exhibited as a compound organism of higher grade. The discussion turned on the adaptation of marine animals to fresh water, on the bulk of organisms relatively to their daily food, and on the proportion which length of animal life bears to intelligence. An abstract of Mr. Barratt's elucidation will be printed hereafter.

BIRMINGHAM AND MIDLAND INSTITUTE SCIENTIFIC SOCIETY.—Photographic Section.—December 5th. Mr. R. Fisher gave a demonstration of the "Platinotype." This is a new method of printing photographs with salts of platinum instead of silver, whereby it is claimed that the results cannot possibly fade. The prepared paper or linen is supplied by the Platinotype Company, who hold the patent; and after being printed is developed by immersion in a hot solution of potassic oxalate. Since the platinum salt does not show any visible change before development, an iron salt is used in addition to that of platinum, in order to guide the operator to the exposure to light required, and this is afterwards dissolved out by hydrochloric acid, and the print finally washed. The resulting colour resembles that of an engraving, and, as such, does not meet with much favour from those accustomed to the warmer tone of silver prints.

BEDFORDSHIRE NATURAL HISTORY SOCIETY & FIELD CLUB.—This Society is trying the experiment of furnishing lecturers on scientific subjects for the towns and larger villages of the county. A committee has been appointed for the purpose of making the necessary arrangements, Mr. Arthur Ransom acting as chairman, and Mr. J. Hamson as secretary. A scheme has been prepared by the Committee and adopted by the Society, providing that upon proper application to the secretary of the Lecture Committee, a lecturer may be supplied. It requires that the lectures shall be brief, popular, and, as far as possible, practical, and it is suggested that objects of the county would be the most proper subjects to expatiate upon. The lecturers are to give their services gratuitously, but the applicants are required to defray all expenses incurred for travelling, refreshments, experiments, etc. The secretary was instructed to send circulars, explanatory of this offer and the terms, to the clergy, chairmen of school boards, schoolmasters, secretaries of local institutes, temperance societies, etc., in the county. A list has been drawn up of the names of gentlemen who are prepared with suitable papers, and upon receiving an application, the secretary negotiates for the subject and date, etc. At present the project is in its initiatory stage, and but two or three lectures have been given under it. It is perhaps premature to form any opinions as to the success of this undertaking, but so far the number of applications has by no means realised the hopes of its promoters. In fact, we are inclined to think science is by no means appreciated in the rural districts of Bedfordshire, whatever may be the case in other counties. The advice of some of your contributors would be acceptable. —J. Hamson.

NOTTINGHAM NATURALISTS' SOCIETY.—Oct. 16.—Mr. G. Mundon read a paper on "Tokens," which was full of interesting facts about the various kinds of tokens that were issued chiefly during the reign of George III. He also exhibited a number of tokens with their attendant forgeries, the more remarkable among them being Bank of England 3/- tokens, with their forgeries, a 1/6 (English), and a 1/6, a 10d., and a 5d. (Irish), with a number of light private tokens, 1/-, 6d., and other forgeries. Nov. 6.—Mr. Henry Blandy, L.D.S., read an interesting and instructive paper on "Some points of interest in the Comparative Anatomy of Teeth," which was illustrated with diagrams, microscopic slides, and specimens. Nov. 20.—Mr. Councillor Hugh Browne read a paper on "What is the meaning of Vegetable Life," which led to a long and spirited discussion. Dec. 4.—Mr. B. S. Dodd (Hon. Sec.) read a paper on "Savoury Dishes (animal and vegetable) not usually eaten," in illustration of a series of dishes, one of which he had had prepared for each meeting of the Society for the past few weeks. The series comprised (1) roast hedgehog; (2) sea-weed jelly and blanc mange; (3) fricassee of frogs (French); (4) rat pie (English barn rats); (5) French snails (from Paris); (6) Iceland moss jelly. The remainder of the evening was devoted to the examination of fresh-water pond life under microscopes.

PETERBOROUGH NATURAL HISTORY, &c., SOCIETY.—November 22nd. Mrs. Dalton exhibited a collection of Fungi; one specimen (name unknown) had five branches each with a fine head. Microscopical exhibits by Messrs. A. W. Beale and J. W. Bodger. December 13th. Mr. A. Edwards read an interesting paper on "Rome and her legions in Britain." The Society has arranged for a course of six lectures, to be delivered in connection with the Gilchrist Educational Trust, on alternate Thursday evenings, commencing January 14th, by the following eminent scientific men: Dr. W. B. Carpenter, C.B., F.R.S., W. Lant Carpenter, B.A., B.Sc., F.C.S., Rev. W. H. Dallinger, F.R.S., Professor P. M. Duncan, F.R.S., Professor L. C. Miall, F.G.S., and R. A. Proctor, Esq., B.A., F.R.A.S.

OUR SUB-EDITORS.

We have much pleasure in stating that the gentlemen named below have been nominated by their respective Societies and have consented to act as sub-editors for the "Midland Naturalist." By their aid we hope to secure concise reports of meetings, original papers, and records of local scientific facts. We hope to be able to add additional names in our next number:—

Mr. E. WHEELER, 45, Cromwell Road, Peterborough.

Mr. T. J. GOLDSMITH, 7, Colsterworth Terrace, Glebe Street, Nottingham.

Mr. J. HAMSON, Spring Road, Elstow, Bedford.

Mr. J. W. NEVILLE, Wellington Road, Handsworth.

NOTE.—*There will be 32 pp. in each ordinary number of this Magazine, but only 28 when there is a plate. The reduction is necessary in order to enable the Magazine to be sent at half-penny postal rate.*

SOME POINTS OF INTEREST IN THE COMPARATIVE ANATOMY OF TEETH.*

By Henry Blandy, L.D.S. Edin.

It is a great advantage to the naturalist if he understands what is expressed by a tooth, should he happen to find one. You have only to present to the comparative anatomist and palæontologist a fossil tooth which has perchance been buried in some cave for thousands of years, and he will, perhaps, be able, from the consideration of its formation, to build up and sketch out the animal from whose head it has come. In this way many of the extinct saurians and mammoths of pre-historic times have been recognised and allied to the reptilia or pachydermata.

Speaking roughly, the teeth of animals may be divided into two great classes—the graminivorous or grain-eating vegetable-feeding animals, and the carnivorous or flesh-eating animals. Between these two is an almost infinite variety of gradations in form and structure. The teeth of the graminivores are flat and broad—adapted for grinding—such as those of the elephant, cow, sheep, and horse, whose lower jaws have considerable lateral motion. Those of the carnivora bite like scissors, and are cutting or chopping teeth. You will have observed that dogs and cats do not chew their food much. Now, the pig is an all-round feeder. He will eat flesh and grain, too; nothing comes amiss to him. He will even eat coal—perhaps because it is of vegetable origin; and we find his molars are broad for this scrunching, but they have cusps like the carnivora, and are very much more like man's teeth than are either cow's or lion's. Then, again, the rodents, or rats, have a pattern of their own. So have the insect eaters, snakes, and fish; and as teeth differ in form, so also do they differ widely in microscopic structure. So that, although there are certain homologies in teeth, there are also unmistakeable differences.

When you see a tooth, before you could attempt to decide finally whose it is, you would have to decide which tooth it was —whether an incisor, canine, premolar, or molar— and which; and you would proceed by elimination. Some animals have no upper incisors, as sheep, oxen, and antelopes; while some have no canine teeth, as rodents, hares, rabbits, rats, etc. If the tooth belonged to a quadruped, there are sufficient distinctive characteristics to enable a skilled odontologist to identify it; while if the tooth belonged to a reptile or fish there would be much greater difficulty,

* Read before the Nottingham Naturalists' Society, Nov. 6, 1883.

since their teeth are so much alike—not being divided into incisors, canines, and molars. They are mostly pointed and sharp, like canines; but you may fall back on structure to some extent. The bulk of the teeth of most fishes is made up of one or other modification of vasodentine or osteodentine; this is often glazed over upon its exterior by a thin film of enamel, so thin as often to appear structureless. Unvascular dentine also forms the teeth of many fishes, and in some is remarkable for the fineness of its tubes; in fact, every form of dentine, from fine tubed hard dentine to tissue undistinguishable from coarse bone, is to be found in this class. The formation of the condyle of the lower jaw and the shape of the glenoid fossa of the temporal bone is of great assistance, as corroborating a diagnosis of the tooth. This will show whether the animal was a ruminant or a flesh-eater by the degree of motion permitted to the lower jaw.

Then, again, as to number of teeth. There are homologies in number, and it will much assist the naturalist in the identification of an animal through its tooth to know which of a number of teeth any particular one is; as for instance, whether it be the first, second, or third incisor, the first, second, third, or fourth premolar, or which molar, just as a dentist should be able to name the exact position in the jaw once occupied by any human tooth that you might place before him. The typical number of teeth in mammalia is believed to be:—Incisors, 3-3; canines, 1-1; premolars, 4-4; molars, 3-3—equal to 22 in each jaw, or altogether to 44. The number of teeth (32) in man is interesting, as being not very far from that which is typical of the great bulk of the class to which he belongs. It is identical with that existing in the whole of the apes which inhabit the old world, and those of the new world only differ from him by the presence of one more premolar, or by the absence of a molar on each side of each jaw. In man's own class (the mammalia) the number of teeth developed may be very great, as in the dolphins, where the greatest number is reached in Pontoporia, namely, 220; while in the narwhal the teeth are reduced to two, only one of which is fully developed. Passing out of man's class, teeth in the reptiles may be many or few; but amongst fishes we meet with every extreme, from a single-pointed tooth on the roof of the mouth, as in myxine, or two above and two below (flat and crushing), as in *Ceratodus*, up to such a multitude that to count them would be a task both useless and difficult, as in muræna—a sort of eel—and the common pike.

The development of teeth next demands our consideration. They are perfectly distinct from the internal bony skeleton, and, like the hair and nails, are appendages of the skin. The teeth of the shark, and of many other creatures, remain imbedded in tough mucous membrane, and never acquire any connection with the bone. Whether teeth have a bony or tegumentary connection with the skeleton has been much discussed, and it may be well here to show some grounds for the belief in their connection with and development from the skin. If a transverse section through the jaw of a dogfish (*Scyllium canicula*) be examined, we shall find that the forming teeth lie upon the inside of the semi-ossified jawbones, the youngest being at the bottom; progressing upwards each tooth is more fully calcified till on passing over the border of the jaw we come to those teeth whose period of greatest usefulness is past, and which are about to be cast off, in the course of that slow rotation of the whole tooth-bearing mucous membrane over the border of the jaw which is constantly going on. The dentine germs and consequently the dentine are indisputably derived from the connective tissue of the mucous membrane immediately subjacent to the epithelium, nor can it be doubted that the enamel organs are simply the modified epithelium of that same mucous membrane. The teeth of man and other mammalia being set in bony sockets has given rise to the opinion that they were developed in the bone, whereas their germs are to be found in the mucous membrane and the subjacent tissue, and the bony sockets grow around the forming teeth; or as in the case of the sharks just quoted there is no bony socket, but simply a membranous attachment. Besides this, the teeth begin to be formed when there is no bone at all.

The attachment of teeth in the various animals is in itself a very interesting study. Although the gradations from one class to another prevent any absolutely correct classification, four principal methods may be enumerated, viz., attachment by means of fibrous membrane, by a hinge, by anchylosis, and by implantation in bony sockets. The fibrous attachment I have already alluded to in the shark. In this animal the teeth formed inside the jaw rise gradually to its crest and then work round to the outside and drop into the sea. This would appear to account for the great numbers of fossil sharks' teeth to be found. Then there is attachment by an elastic hinge. The possession of moveable teeth able to yield to pressure and subsequently to resume the upright position was formerly supposed to be confined to the lophius (angler) and its immediate allies. They have, however, been found in the common pike (esox) and in the gadidæ (cod tribe), so that as they occur in these fish, so widely removed from one another in other respects, it is probable that further investigation will bring to light many other examples of this very peculiar method of attachment, eminently suited to, and hitherto only discovered in, fish of predatory habits. In the angler, which obtains its food by lying in ambush at the bottom, which it closely resembles in colour, many of the largest teeth are so hinged that they easily allow an object to pass into the mouth, but, rebounding again, oppose its egress. These teeth are held in position by dense fibrous ligaments radiating from the posterior side of their bases on to the subjacent bone, while the fronts of the bases of the teeth are free, and when the teeth are pressed towards the throat rise from the bone. The elasticity of the ligament is such that when it has been compressed by the tooth bending over towards it, it returns it instantly into position with a snap. Many of the teeth of the angler are, however, like most fishes' teeth, anchylosed firmly. The hake possesses two rows of teeth, the inner or shorter of which are anchylosed, whilst the outer and longer are hinged. Now, the common pike possesses hinged teeth, whose resiliency is provided for in another way. Here the teeth which surround the jaws are anchylosed by a development of osteodentine, which becoming continuous with the subjacent bone unites them to it. The manner of development of this is by rods of calcifying material shooting down through the central pulps; in the hinged teeth also these trabeculæ shoot down and become continuous with the subjacent bone, only instead of rigidly ossifying they remain soft and elastic, so that the tooth is like an extinguisher fastened down by a large number of elastic strings attached to different points of its interior and hinged at one side.

There are some peculiarities in the form and formation of elephants' teeth which it may be interesting to notice. In the first place the tusks are incisor teeth, and not canines, as might be supposed, and they grow from persistent pulps like the teeth of rodents. These tusks grow to an enormous length; in the Indian elephant they are not so large as in the African species, and the tusks of the female are much shorter than those of the male. In the African elephant no such difference in size has been established. A male makes use of his tusk for all sorts of purposes. Thus, when a tamed one is given a rope to pull, he will, by way of getting a good purchase, pass it over one tusk and grasp it between his molar teeth. The tusks of the Siberian mammoth, whose remains are abundant, are strongly curved, and attain the length of 13ft., and a weight of 200lb. each. A pair of African tusks exhibited at the Great Exhibition of 1851 weighed 325lb., and measured 8ft. 6in. in length, and 22in. in circumference, but the average tusks imported from Africa do not exceed 20lb. to 50lb. in weight. Indian elephants seldom have tusks attaining very large dimensions. One was, however, shot by Sir Victor Brooke with a tusk 8ft. long, weighing 90lb, The female elephant's tusk is liable to the attacks of a dipterous insect, which imbeds itself in the gums, and either gnaws off the ivory in a circle or the ivory is absorbed owing to the irritation set up by the insect. The tusks of the elephant are implanted in long and stout sockets, and grow from persistent pulps throughout the life-time of the animal.

Some curious examples of spear heads and bullets found in the centre of tusks exist. In these cases the missile has penetrated into the pulp cavity, where the bone is thin. The ivory has grown around it, and, increasing in length, the tusk has carried the iron forward, which, when the tusk has been cut up by the turner, has been discovered. In the museum of the Odontological Society is the head of a spear, measuring 7½ by 1½ inches, so embedded. In 1879 there were 9,414cwt. of ivory, of the value of £406,927, imported into this country.

Though the elephant has during the course of its life 24 molars, they are not all in place, nor, indeed, are they all actually in existence at the same time. Only one whole tooth on each side or portions of two when the front one is nearly worn out, are in use at the same time. After a tooth has been in use for some time and is worn down, a new tooth comes up to take its place behind it, and absorption in the old tooth being set up, it is shed off, and a new tooth pushes up into its place. Each successive tooth is of greater size than its predecessor; thus in the Indian elephant the first tooth has, on an average, 4 transverse plates, the second has 8, the third 12, the fourth 12, the fifth 16, the sixth 24 to 27. In the African elephant, in which the individual plates are much broader, they are fewer in number.

Of course, everyone will have noticed that in the grinders of the horse or cow the enamel does not surround the tooth, as in our teeth, but that it runs into the tooth substance in a peculiar manner, yet constant in its devious path. There is a wonderful evidence of design in this. If you took a piece of wood, however rough and hard at first, and made a rub-stone of it, in time its surface would be worn even and smooth —the harder the wood the smoother and more polished would it become. But if you were to place, first a layer of boxwood, then a layer of steel, and then a layer of deal side by side, and screw them into a solid block and use it as a rub-stone, your deal and boxwood would wear away before your steel, and your rub-stone would remain rough. Now, in the elephant, which chews an immense amount of grain and even young trees, you have first a layer of cementum, then a layer of very hard enamel which will turn the edge of the hardest steel instrument, and soon spoil a file, and then a layer of dentine. So that, as will be seen from the transverse section of an elephant's tooth, it is quite impossible to polish it evenly, and it cannot but be felt that the surface is rough. You can distinguish the African from the Asiatic elephant by its tooth. In the African the enamel winds in and out in two lines like the sinuous course of the sea serpent. In the Indian the enamel forms rings or long oval islands in the tooth.

I have already alluded to the fact of the elephant's tusk growing from a persistent pulp, as does that of the narwhal (*Monodon monoceros*), the ancient unicorn, whose tusk will grow to a length of ten or twelve feet; but we have interesting examples of persistent pulp and continuous tooth-growing nearer home, in the rodents—the rats, rabbits, hares, etc. Here I have to introduce to your notice one of the most beautiful specimens I have seen, specially lent to me to show you by my friend, Mr. F. H. Balkwill, L.D.S., of Plymouth. It is the skull of a rat. The lower incisors have by some means become inclined to the left, and missing the upper ones, have not been worn away by them, and have grown upwards, curling backwards an inch long; while the right upper incisor has grown in a circular and spiral direction, completing a circle and a half and projecting from the side of the palate bone about three-eighths of an inch. The left incisor has likewise curled round, but has penetrated the margin of the *pre-maxilla*, and its point is shown by a small portion of the bone having been cut away about one-eighth of an inch short of completing the circle. These gnawing animals would soon be without teeth did not their incisors grow as fast as they wear them down. There are many examples in museums of an incisor tooth which, from some irregularity of position or from having nothing to oppose it, has grown and grown in a circle until the point of the tooth, recurving on the head, has either pierced the skull or so prevented the animal opening its mouth that it has died of starvation. At our last Goose Fair, in the wild beast show, the keeper showed a large handful of chewed wood which was made by the porcupine, to whom they were obliged to give a chump of wood every day upon which he might exercise his teeth. There are many points of great interest to naturalists in the teeth of snakes, insect-eating animals, and the carnivora; but one would have to write a book and give very many illustrations to do more than touch the borderland of this extensive subject.

THE PRINCIPLES OF BIOLOGY.*

Exposition of Chapter I. Organic Matter.

By Alfred Hill, M.D., F.I.C.

Organic Matter.

Of the four chief chemical elements of living bodies, three are gaseous, viz., oxygen, hydrogen, and nitrogen, and one is solid, viz., carbon. Until recently these gaseous elements had resisted all attempts to reduce them to the liquid form, and their great mobility has a significant bearing on the redistributions of matter constituting evolution.

The compounds produced by the union of these elements have physical properties which are *resultants*, in which the properties of the elements are still in action, though mutually obscured, so that the molecular mobility of the various compounds is influenced by the molecular mobility of its constituents.

Chemically the affinities of hydrogen, carbon, and nitrogen are of narrow range and low intensity; this chemical indifference is most marked in the case of nitrogen.

Allotropism, or the faculty of elementary bodies to assume different physical states, is well seen in the organic elements; while isomerism, the analogue of allotropism, is exhibited in the compounds. This is strikingly true, not only of carbon and oxygen, but also of sulphur, phosphorus, silicon, silica, and even of iron, which latter are essential constituents of organic bodies, although their relative quantity be not large.

The four principal organic elements present extreme antitheses—chemical, between oxygen and nitrogen; physical, between carbon and the three gases. By these contrasts of properties differentiation and integration are facilitated, for while unlike units are most easily separated, they are also most easily segregated.

The binary compounds of these four elements have less molecular mobility than the elements themselves, while it is greater than that of binary compounds in general; chemically

* It is intended to give, under the above heading, from time to time, short abstracts of the addresses or expositions of the portions of Mr. Herbert Spencer's works now under consideration by the Members of the Sociological Section of the Birmingham Natural History and Microscopical Society. By this means a continuous record of the transactions of the Section will be preserved, and it is hoped that the attention of other Naturalists may be directed to Mr. Herbert Spencer's writings, in this somewhat popular form. Where illustrations are given these will be mentioned also.

they are less stable than ordinary binary compounds. Those which form parts of organised tissues are hydrocarbons, and are the most unstable of their class.

Ternary compounds, with their greater complexity, show a diminished mobility; they include alcohols, fixed oils, solid fats, starch, sugar and resins, &c.; in chemical stability they are inferior to the binary compounds.

The quaternary compounds, containing all the four chief organic elements, and including those which are constituents of the living tissues, as albumen, fibrin, casein, as well as some which result from the decomposition of the tissues, such as urea and kreatin, exhibit instability and inertness carried to the extreme. Atomic complexity here reaches its maximum, as shown by Mulder's formula for albumen $10\ (C_{40}\ H_{31}\ N_5\ O_{12}) + S_2 + P$ containing 883 ultimate atoms. Such chemical and physical properties are favourable to rearrangements and decompositions.

The part played by the tissues in relation to the phenomena of dialysis is here somewhat fully entered upon; the question is too lengthy for satisfactory abstraction and should be read at length; it is as interesting as it is important.

In conclusion it is shown how in organic materials and tissues those conditions of chemical indifference, variety of complexity and stability, molecular mobility, plasticity, different diffusibilities of colloids and crystalloids, and isomerism aided by the influence of heat, are fulfilled so as to effect that redistribution of matter and motion which constitutes evolution.

Mr. Francis Galton has published a thin quarto book under the head of "Record of Family Faculties," consisting of tabular forms in which anyone who likes to collect this kind of information can enter certain particulars concerning "his sisters, his cousins, and his aunts." In an explanatory preface he gives directions how this is to be carried out, and also offers £500 in prizes for the books sent in when filled with the required details; no prize to be greater than £50 nor less than £5. This may be considered a kind of "Family Game," with the recommendation that the result, if truthfully recorded, will have a scientific value; for it need scarcely be said, to those who are acquainted with Mr. Galton's previous writings, that his object is to collect data for further studies of *heredity*. In the contest the greatest value will be attached to the completeness with which all the members of a given family are entered, together with their distinguishing traits of character and faculties. All information thus contributed will be considered confidential. The book is published by *Macmillan & Co.*, and the price is half-a-crown.

OUR MARINE ALGÆ.

By Rev. Henry Boyden, B.A.

(*Continued from page 6.*)

We now come to the fructification of our Marine Algæ; their reproductive organs form a difficult subject, into which I have as yet neither the learning nor the appliances to enter with any degree of satisfaction. The organs of reproduction are called spores, tetraspores, antheridia, and zoospores. It is supposed that spores are formed by certain cells which have the power of attracting to themselves the contents of adjacent cells; and that the fertilising influence is imparted to the sporangium at an early stage of its growth, and not to each individual spore. Spores are formed in a capsule, or ceramidium, which is an ovate conceptacle pierced by a terminal pore containing a tuft of spores rising from the base of the conceptacle. The capsule is external, and it is a mode of fructification for which the Polysiphonias are conspicuous. Spores are also embedded among sporiferous filaments called paraphyses. They are found also embedded in soft, pulpy berries, which are either simple or variously lobed and clustered on the sides of the branches, at one time enclosed, at another surrounded by an involucre. These may be seen on specimens of the Ceramiums. In other cases the masses of spores are found attached, not to the outer surface but to the inner, the fronds consisting of a thin membrane rolled round.

Another kind of fruit consists of tetraspores, so called because on maturity they break up into four sporules, though often into three and sometimes six. The division is various, for there is the cruciate, the tripartite, and the zonate.

It is thought that the spores are true spores fertilised by means of an antheridium, while the tetraspores, totally distinct, are mere gemmules or buds of the simplest structure, which are cast off by the parent plant, carrying with them sufficient vitality to become the nucleus of fresh individuals. "Each tetraspore consists of a dark-coloured mass of endochrome enveloped in a transparent membranous sac, and marked by the lines of division" as described. The tetraspores are variously placed, some scattered singly, others gathered into sori or clusters, others on branchlets, some in external warts, nemathecia; others in pod-like receptacles, the stichidia; and their position forms a mark of the different genera.

The antheridia are reproductive organs very imperfectly understood. Dr. Harvey describes them thus:—"The antheridia are oval, somewhat pointed at one end, and contain a reddish orange granule, and they are furnished with two extremely vibratile hairs or cilia, one of which issues from the narrow extremity of the corpuscle; the other, which is of greater length, from the coloured granule. The corpuscles escape from the antheridium into the surrounding water, where they perform rapid circular movements like the zoospores of the green series of Fresh-water Algæ, the narrow end of the corpuscle being in front, and the cilium rising from the coloured granule trailing behind."

In regard to the reproductive agency of the zoospores, the following description may be given. The cells at first are filled with endochrome nearly homogeneous and fluid; this becomes more granulated, the granules adhering to the inner surface of the wall; they then detach themselves and float freely in the cell, at first irregular in shape, then spheroidal. Afterwards they congregate into a dense mass in the centre of the cell, when one by one the granules, becoming detached, move vivaciously in the centre of the cell, push against the sides of the cell-wall till they pierce it, then escape into the surrounding water, continuing their movements until they become fixed to some submerged object, where they develop cells that grow into algæ, similar to those from whose cells they issued.

Thus, in review, we have the root and frond with their various characteristics, the cellular structure, and the organs of reproduction, as criteria by which our Marine Algæ are classified and arranged There are three sub-orders; first—the Rhodospermeæ, which are distinguished by the red colour of their spores, and their red or brown fronds; second—the Melanospermeæ, distinguished by their olive-green spores and similarly coloured fronds, turning almost black when dried; and thirdly we have the sub-order of Chlorospermeæ, known by their sea-green spores and fronds, except in several species where they are purple. All the series are divided into families, genera, and species, these being determined by the fructification, cellular tissue, form and colour of the frond. All our Marine Algæ are included under three sub-orders, 25 families, 122 genera, and 376 species. But many of the species are exceedingly variable, none more so than the *Chondrus crispus*, needing very careful microscopic examination to discriminate them.

Attempts have been made by botanists to classify our seaweeds according to definite zones of growth, and so we hear of the Fucal, or littoral zone, commencing at high water mark, in which the Melanosperms abounds; the Laminarian zone, where forests of the large sea-weed *Laminaria digitata* luxuriate; and still further towards low water mark, and only uncovered at the ebb of spring-tides, the Coralline zone. But these divisions are only roughly descriptive, as the gradations are not found on all shores, and species of the different sub-orders are much intermixed.

Of the economic uses of our sea-weed I will say but little. Man has not largely benefited by them in a direct way. They have been of some mercantile value as affording materials for the manufacture of kelp and iodine; and farmers near the coast cart off great quantities as manure for their lands. Of the edible qualities of our sea-weeds I cannot boast. The *Chondrus crispus*, or Irish moss, used to be in great request as affording a nourishing diet. "Dulse and Tangle" were formerly cried for sale through the streets of Edinburgh, and eaten as a relish between slices of bread and butter.* For savoury dishes and delicious breakfasts we must assign the palm, not to our sea-weeds, but to their country cousins the fungi. But if voracious man gets little gain from them, there are myriads of God's lesser creatures, which have a life to perpetuate and enjoy, that find abundance of food, groves of shelter, places of defence, and gardens of pleasure, in the Algæ that decorate our sea-washed shores. A writer in the August number of "Good Words," in an article on "The Study of Small Shells," says: "A calculation necessarily rough, but as likely to be under the truth as over it, led to the conclusion that, if it were possible to examine all the sea-weeds which the lowest tide leaves bare for a stretch of only twenty-five or thirty yards along that shore, 100,000,000 living shell-bearing molluscs would be found. Of all these not even the smallest would, strictly speaking, be a microscopic object, though certainly requiring a lens for the determination of its species." The sea-weeds so furnish food for the molluscs, these feed the fishes, and by them we are fed.

I have only to add a few words on the æsthetic value of our Marine Algæ, and on this topic I scarcely dare to speak, so enthusiastic do I feel. Holiday hours spent, say among

* Sea-weeds are also said to be the basis of many jellies, gelatine, etc., which are found in commerce. Those which are made from this source may be recognised microscopically by the number of marine *diatoms* enclosed in them. Good hauls of rare species have been obtained from such unlikely material.—Ed.

the igneous rocks that break up the shores of North Berwick—spent in perfect solitude, excepting the seagull and Solan goose—spent in peering into the natural aquaria, the little rocky pools, fringed and decorated with sea-weeds of every colour, and "beautiful as a dream"—these are hours that never can be forgotten. And sea-weeds are beautiful, both in form and colour, even when dead, if carefully and neatly displayed. I think the hundred mounted specimens I have brought, gathered and prepared by myself at different times—some twenty years ago, and some this year—compel admiration on æsthetic grounds. I thus mounted them that I might hang them on the walls of schoolrooms, as I do my flowering plants, and as I have done many times, to try to cultivate the taste of my poorer neighbours, and give them a love for pure pleasures in the study of simple things. There is a sense of the beautiful which God has implanted in every breast—this is my belief—and my effort has been to educate this sense of the beautiful by presenting natural pictures to the eye, as there are so many laudable attempts to gratify the ear by the concord of sweet sounds. I have often thought how attractive the little homes of our artisans might be made by themselves if they had a taste for natural history; what cottage museums they might form for the delectation and instruction of their friends and neighbours; and I have tried to foster the feeling—tried to make them partakers of my delightful recreations, though with little result.

POSTSCRIPT.

As questions were put to me in regard to the mounting of sea-weeds, I will add a few directions :—

1. Wash your specimens in fresh water to free them from superfluous salt.

2. Pour clean water into a vessel—a wash-hand basin—and put in your selected specimen, turning it about with the finger till the frond unfolds; then immerse your card or paper, cut to the requisite size, beneath the specimen, and move it about till it sinks in a natural position on the paper.

3. Lift it from the water with great care, and slant it for a short time for the water to run off; then put it between sheets of blotting paper under slight pressure, that of a brick or book, having a sheet of stout card-board above and below.

4. Change your blotting paper twice the same day, apply greater pressure as the drying proceeds, and in two days, in summer, your specimens will be ready for the herbarium.

As a rule, the sea-weeds will adhere to the paper, but those of thicker texture will have to be secured by gum.

THE SYENITES OF SOUTH LEICESTERSHIRE.

By W. Jerome Harrison, F.G.S.

(*Continued from page 11.*)

General Conclusions.—Having now examined all the points at which these syenitic rocks crop out in South Leicestershire, we may briefly sum up, and point out the conclusions derivable from a minute study of the rocks and the conditions under which they occur.

(1) The rock, in all the exposures, has a general similarity, so that it is difficult to tell from which pit any hand specimen came. It is a syenite, a crystalline, unstratified, unfossiliferous rock, all of which facts clearly point to its being igneous or fire-formed—*i.e.*, it has been melted, and has slowly cooled down. Whether the differently coloured, finer-grained masses, so often seen included in the syenite, may not be lumps of some older rock—perhaps slate—which the syenite has enveloped, incorporated, and altered—is a very interesting question. The remarkable specimen alluded to, from Cauver Hill Quarry, might certainly seem to point in this direction.

(2) As to the age of the rock. It is clearly connected with the Charnwood Forest. Series; the coarse slate seen in Enderby Quarry belongs either to the Charnwood Pre-Cambrian Beds or to the Cambrian strata which we now know to rest upon them. If we could strip off the red marls we should find these old Palæozoic rocks forming an uneven land surface and connected with the equally old, or older rocks of Groby and Markfield; in fact, at a point about half way, called "Baron's Park," near Kirby Muxloe, it is reported that syenite was struck in a boring at a depth of 118 feet. This underground extension of the Charnwood Rocks forms the easterly boundary of the Leicestershire coal field, whose coal seams rise up against it along a line extending from Desford to Hinckley. At a point called Sapcote Freeholt, about two miles east of Hinckley, on the land of the late Mr. T. Frewen, a boring executed by Mr. J. A. Bosworth, F.G.S., passed through about 540 feet of red marls. At this depth it entered hard slates, which were penetrated to the great depth of 1,655 feet. All the slaty beds were standing up on end, marking the position of a boundary line close to and on the east, this boundary line being formed by the ridge of igneous rocks whose exposed summits we have been describing. We must refer these slates to the Cambrian formation, whose presence in the immediate vicinity (between

Nuneaton and Atherstone) we were able to prove some time back. The same Cambrian Beds have also been reached in two boreholes put down on the east side of Leicester, between the Spinney Hills and the village of Evington. In the first of these borings hard, much-jointed, bluish slates were reached, at a depth of 728 feet, and pierced to a total depth of 819 feet. In the second boring, a little further east, very similar slates were touched at 836 feet, and the boring attained a total depth of 1,002 feet. Other borings near Market Bosworth have revealed the presence of precisely similar coarse red, purple, and blue slates, underlying the coal measures.

On the whole, it seems probable that all the syenites of South Leicestershire are intrusive in rocks of Cambrian age. As to the actual date of the intrusion we cannot be certain, but it may possibly have taken place during the Lower Silurian period, when, as we know, volcanic action was rife elsewhere in Britain.

Economic Uses.—Our modern systems of paving have brought into great request rocks possessed of a sufficient degree of hardness and toughness to stand the wear and tear of our streets. As we stand in any syenite quarry we observe the rock to be crossed in two or three directions by well-marked cracks and fissures. These are termed *master-joints*, and between them the blocks of stone are again divided by minor joints. These joints greatly facilitate the working of the rock; which, indeed, it would be impossible to quarry if it were not for their existence. A mass of tough boulder-clay, in which there are no joints, is dreaded by a navvy far more than the hardest granite.

In the syenite quarries the first task is the removal of the surface soil. Holes are then bored in the rock with iron rods to a depth of ten or twenty feet. In these holes charges of powder are inserted and fired, by which a large quantity of rock is dislodged and made to fall upon the floor of the pit. The great blocks are then still further split up by powder or by dynamite into masses of a more convenient size. Skilled workmen now take the stone in hand, and, by properly directed blows with heavy hammers, divide it into square or oblong masses (four-inch cubes are most commonly made) termed *setts*, or into longer pieces called *kerbs*. The smaller fragments are broken up and used as macadam.

The South Leicestershire syenite splits, "cuts," or cleaves very readily. It is largely used in the neighbouring towns and in the eastern counties; many thousands of tons are also sent to London annually. The average price of good *setts* is about twenty-seven shillings per ton.

SPECULATIONS ON PROTOPLASM.

An article in the "American Naturalist" for last September contains some suggestive remarks under the title of "The Variability of Protoplasm." We are accustomed to speak and reason as if protoplasm were all of one kind, although, of course, on consideration we should readily admit that this cannot be true. Differences are observed on comparing the protoplasms of distinct organisms, which go to show that they are chemically distinct. Some forms of it coagulate in the presence of water, others do not; there are differences in colour, transparency, and behaviour with chemical re-agents which all point to some difference in ultimate composition. For instance, it is well known that some species of bacteria take a colouring matter which has no effect upon others; and, in fact, Professor Koch's process for demonstrating *Bacillus tuberculosis*, and also Hansen's for *B. lepræ*, are founded upon this very property. There is, besides, that wonderful fact, the great *arcanum* of life, that two little cells apparently undistinguishable from one another may be germs proceeding from two distinct beings, and may develop into creatures totally unlike. We are led to the conclusion that the protoplasm of each species is a distinct organisation, and may be of a molecular composition more or less peculiar to itself.

Moreover, some of the properties which were formerly thought to be distinctive of protoplasm, such as its motion and its capability of surrounding itself with a pellicle (the ectoplasm) of a different constitution from the interior mass, have been now met with in other substances of a truly inorganic nature. A small mass of cholesterine, for instance, if placed in a suitable fluid, surrounds itself with a membrane, which possesses that peculiar dialysing power that is often spoken of as peculiar to organic membranes, and permits liquids to pass through it by a process similar to osmosis. These pseudo-cells have heterogeneous contents and produce granular particles in their interior, and are, therefore, both in form and composition similar to the proximate elements (cells) of which organic tissues are composed. Certain speculative minds have thus been led to imagine that this similarity constitutes identity, and that thus no barrier exists to the conception of the formation of living beings from non-living matter.

But this identity is not proved. A great flood of light has recently been thrown on the constitution of protoplasm, and it is now known that the crude and simple idea of a cell, on which the hypothesis was founded, falls far short of representing its real complexity. A series of papers about to appear in the "Midland Naturalist," from the able pen of Professor Hillhouse, of the Mason College, will render this point clear.

The speculation has been carried still farther. It is pointed out that to suppose consciousness and life to be confined to the planet on which we dwell is an improbable assumption. The idea of a plurality of worlds has had a fascination for many minds of the highest rank. But it is obvious that, if living beings exist in the other planets of our solar system, they cannot be composed of what *we* call protoplasm. In Mercury, for instance, our fundamental basis of life would be resolved into its component gases, and in Saturn would be frozen into a hard and dense solid, "of which edge-tools might be made." The protoplasm of one planet cannot, therefore, be identical with that of any other planet.

In the "Principles of Biology," Herbert Spencer shows that the peculiar fitness of organic substances, as we know them, for forming the vehicle of life, resides in their many-atomed chemical composition and consequent molecular instability. But these qualities are not necessarily confined to protoplasm. We can, indeed, partly see why *our* protoplasm is constituted as it is. Carbon, oxygen, hydrogen, and nitrogen are abundant in our atmosphere, with its proportions of carbonic acid gas and watery vapour, and are consequently brought with ease within the reach of every living thing.* But it is not difficult to imagine that, with other environment, matters might be quite different, and yet the essential principle of organic chemistry remain the same. In our case, certain molecules are deoxidised in a vegetable cell, and then reoxidised in an animal, and there is no reason why this mutual interchange of function might not take place with other oxides for its basis. In fact, wherever heat is found, there life is possible. Only when the last dim ray from cooling suns has winged its way across the illimitable void, when the last foot-pound of energy is dissipated into the depths of space—only then need the cold and pulseless universe feel the final throb of life.

W. B. G.

* The question, whether plants derive their nitrogen directly from the air, or from the nitrates, etc., in the soil, is here unimportant, as in either case it comes ultimately from the former source.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(Continued from page 15.)

LABIATÆ.—Continued.

PRUNELLA.

P. vulgaris, *Linn.* *Self-heal.*

Native: In woods, pastures, and on waysides and heaths. Common. June to October. Area general.

SCUTELLARIA.

S. galericulata, *Linn.* *Common Skull-cap.*

Native: By rivers, canals, pools, ditches, and marshes. Locally common. July, August.

I. Back of the Stews at Edgbaston, *With.*, ed. v., iii., 666; Bradnock's Marsh, *R. Rogers;* Sutton Park; Coleshill Pool; Knowle and Solihull Canal; Elmdon; Olton Reservoir.

II. Side of the Arrow and River Alne, *Purt.*, i., 282; banks of the Leam, Leamington, *Perry, Fl.;* several places near Rugby! *R. S. R.*, 1871; Salford Priors, *Rev. J. C.;* Honington, *Newb.;* Kineton, *Bolton King;* Holywell and Stratford Canal; canal, Sowe Common; Ansty.

S. minor, *Linn.* *Lesser Skull-cap.*

Native: In marshes and bogs, by streams and pools. Rare. July, August.

I. Packington! *Aylesford, B. G.*, 635; bogs, Sutton Coldfield! *Rufford, Purt.*, i., 283; Coleshill, *Bree, Mag. Nat. Hist.*, iii., 165; Bannersley Pool! *Herb., Perry*; Coleshill pool and bog; Marston Green.

MARRUBIUM.

M. vulgare, *Linn.* *White Horehound.*

Alien: On roadsides. Very rare. July.

II. Near Oversley Lodge, near Alcester, *Purt.*, i., 274; Princethorpe, *R. S. R.*

I have searched for this several times, but without success.

BALLOTA.

B. nigra, *Linn.; a. fœtida* (Lam.) *Black Horehound.*

Native: On hedgebanks, waysides, and pastures. Locally common. July to September.

I. Ward End, *W. B. Grove;* Boldmir; Middleton Heath; Marston Green; Temple Balsall; Hampton-in-Arden. Occasionally with white flowers.

II. Stratford; Tredington; Shipston, *Newb.;* Alveston pastures; Wixford; Bidford; Wellesbourn Hastings.

Although on the whole a common plant it is very local in some of the districts.

STACHYS.

S. betonica, *Benth.* *Wood Betony.*

Native: In woods, on banks, and by waysides. Locally common. June to August.

I. Middleton; Wishaw; Minworth; Duke End; Edge Hill, and Kingsbury Woods; Solihull; Hampton-in-Arden; Berkswell; Fulford and Forshaw Heaths.

II. Green's Grove, Hatton; Bagington Park, *Perry*, 1817; near Rugby! Princethorpe Wood! *R.S.R.;* Cubbington; lanes about Corley and Meriden; Alveston Pastures; Austey Wood, Wootton Wawen; Arrow; Ragley.

Occurring more or less abundantly throughout the whole area but often at wide intervals.

S. palustris, *Linn.* *Marsh Woundwort.*

Native: In damp and marshy places, by waysides. Rather local. June to August.

I. Shustoke; Coleshill; Duke Bridge; Maxtoke; Meriden Marsh; Bradnock's Marsh; Knowle; Beardsmore, Hockley; Boxtrees, Hockley, etc.

II. Banks of the Avon and other places near Rugby, *R.S.R.;* Binton.

S. ambigua, *Sm.* *S. sylvatici-palustris* (Wirtz.)

Native: On damp places near waysides. Local. June to August.

I. Duke Bridge, near Shustoke, with *S. palustris;* Haylane, Hockley; Monkspath.

II. Beausale Common, *H. B.*, *Herb. Brit. Mus.;* Alveston pastures; Alcester.

Although distinguished as a species, I do not think it is more than a variety of *palustris.*

S. sylvatica, *Linn.* *Hedge Woundwort.*

Native: In woods, on banks, waysides, etc. Common. June to September. Area general.

S. arvensis, *Linn.* *Corn Woundwort.*

Colonist: In cultivated fields and on railway banks. Rare. June to September.

I. Cornfields near Hartshill Hayes; railway banks, Sutton Park, 1877-8.

II. In a cornfield near Alcester, *W. C.*, *Herb. Perry*, 1854; Brandon, on railway banks, *T. Kirk;* near Compton Verney, in cornfields.

[*S. annua*, Linn. Occurred as a casual on the new railway banks in Sutton Park, 1877.]

GALEOPSIS.

G. Ladanum, *Linn.* *Red Hemp Nettle.*

Colonist: In cornfields, quarries, and waysides, in calcareous soils. Very local. July to September.

II. In a quarry near Stratford-on-Avon, *With.*, iii., 652; near Church Lawford, *R.S.R.;* Chesterton; Tachebrook, *Y. and B.;* near Halford; Fosseway, near Lambcote, *Newb.;* Steeple Hill, Bidford; Exhall; Wixford; Binton; Red Hill; Wilmcote; Drayton, near Stratford-on-Avon.

G. versicolor, *Curt.* *Large-flowered Hemp Nettle.*

Colonist: In cultivated land. Rare. July, August.

I. Near Coleshill, *Aylesford, B. G.;* under a moist hedge at Birches Green, near Birmingham., *With.*, ed. 7, iii., 713.

II. In a turnip field at Milcote, near Stratford-upon-Avon, *Purt.* iii., 566; Whitnash; Myton, *Y. and B.;* in a potato field near the late Mr. Purton's, near Alcester, *Blox.*, *N. B. G. S.;* bank beyond Bilton, *R. S. R.*, 1880; Edge Hills, *Bolton King.*

G. Tetrahit, *Linn.* *Common Hemp Nettle.*

Native: In woods, on banks, and field borders. Common. June to September. Area general. With white flowers in several districts.

LEONURUS.

L. Cardiaca, *Linn.* *Motherwort.*

Denizen or alien: On banks and waysides. Very rare. July, August.

I. In a lane near Hams Hall, *W. B. Grove*, 1882; in a lane at Boldmere, near Sutton, for many years; now extinct.

II. King's Coughton, *Purt.* i., 285; near Hatton, *Herb. Perry*, 1823. The Boldmir plant appeared to be a mere casual weed.

LAMIUM.

L. amplexicaule, *Linn.* *Henbit Dead Nettle.*

Native: In cornfields and on waysides. Local. March to July.

I. Boldmir, near Sutton; Marston Green; Coleshill Heath; Solihull.

II. Near the Aqueduct, Emscote, *Perry*, 1817; walls at Thurlaston, *R. S. R.*, 1877; Honington, *Newb.;* Walton Village; Bidford; Offchurch; Binley; Brandon.

L. intermedium, *Fries.*

Native: On banks and in cultivated ground. Rare. July, August.

II. In an allotment near Dunchurch, *R. S. R.*, 1877.

L. incisum, *Willd.* *Cut-leaved Dead Nettle.*

Colonist: In cultivated land. Rare. June to September.

I. Field near Stonebridge.

II. Fields near Whitnash! *Cross*, *Herb. Perry;* fields near Fern Hill Wood! *H. B.*

L. purpureum, *Linn.* *Red Dead Nettle.*

Native or colonist: On banks, in cultivated land and gardens. Common. February to November. Area general.

L. maculatum, *Linn.* *Spotted Dead Nettle.*

Alien: On banks. Rare. June to August.

I. Hampton-in-Arden! *Y. and B.;* on banks in a lane from Coleshill to Maxtoke; banks near Packwood.

II. Myton.

b. hirsutum. Allesley, *Herb. Perry*, 1853.

(*L. lævigatum.*) Allesley! *H. B.*, *Herb. Brit. Mus.*, 1873.

Growing abundantly on the banks of a stream under the footroad from Allesley to Coventry in 1881, probably planted by the late Rev. W. T. Bree.

L. album, *Linn.* *White Dead Nettle.*

Native: On banks and in waste places. Common. May to August. Area general.

L. Galeobdolon, *Crantz.* *Yellow Archangel.*

Native: In woods and on dry banks. Locally common. May, June.

I. New Park, Middleton; Coleshill; Hampton-in-Arden; Arley; Hartshill; Kingsbury; Fillongley; Solihull; Umberslade, etc.

II. Oversley, Rose Hall, *Purt.* i., 278; near Lillington, and in Warwick Castle Park, *Perry*, 1817; near Crackley Wood! *Perry*, *Fl.;* common at Allesley! *Bree*, *N. B. G. S.;* Stoneleigh Woods; Arbury Hall! Radford! Keresley, *T. Kirk*, *Phyt.* ii., 971; Haywood! *Y. and B.*, near Rugby! *R.S.R.*, 1877; Edge Hills, *Bolton King;* Berkswell; Rowington canal bank; Redhill; Billesley; Combe Woods.

AJUGA.

A. reptans, *Linn.* *Common Bugle.*

Native: In moist woods, on moist waysides and banks. Common. May to August. Area general.

TEUCRIUM.

T. Scorodonia, *Linn.* *Wood Sage. Wood Germander.*

Native: In woods and on heaths and dry banks. Locally common. July to September.

I. Sutton Park; New Park; Kingsbury and Edge Hill Woods; Coleshill Heath; Hampton-in-Arden; Berkswell; lanes about Solihull.

II. Pophills Lane; about Pitchell, Ragley Woods! etc., *Purt.* i., 273; Hatton Wood; between Hatton and Warwick; between Leek Wootton and Stoneleigh! *Perry*, *Fl.;* Wilmcote; Hatton Rock, *Herb. Per.;* road between Rugby and Hill Morton, *Baxter*, 1831; Combe Woods! *R. S. R.;* Corley Wood; Waverley Wood, near Stoneleigh; Alvetson Heath.

(*To be continued.*)

"Religion: A Retrospect and Prospect."—Mr. Herbert Spencer's remarkable essay in the January number of the "Nineteenth Century" may be mentioned here, on account of the boldness with which the author puts forward his claims, so opposed to the ordinary doctrines, but which, nevertheless, he thinks to be not inimical to the growth of truly reverent feeling on this topic. Towards the end of the essay, however, where Mr. Spencer treats of an objection which he himself acknowledges would be fatal if it could not be refuted, he shows symptoms of weakness, and his answer to the objection is far from convincing.

Reviews.

Reminiscences of Travel in Australia, America, and Egypt. By RICHARD TANGYE. 8vo., 290 pp., illustrated. Price 6s. Cornish Brothers.

IF it be wondered how so busy a man as the head of a great engineering firm could find time to write a book, the explanation will be found in the preface to this work, from which it will be seen that it was accomplished during the enforced leisure of a long voyage. As for the book itself, we may at once say that there is not a dull page in it. Many years ago we visited the Australian Colonies, and we have certainly never since met with so vivid and accurate a description of life on board a passenger ship, and the conditions of existence in that new world across the sea, as are contained in this most interesting volume.

For natural phenomena the author has a keen eye; take his description of the shadows of opaque objects in tropical regions—"In passing under a vertical sun the old proverb 'may your shadow never grow less' is entirely out of place . . . . When standing upright my shadow was about two feet in diameter, and it looked like the shadow of the brim of my hat all round my feet."

In the account of the visits made to Victoria and to New South Wales respectively, perhaps the most important point is the testimony which Mr. Tangye bears to the ill effects of the system of protection in the former colony as compared with the prosperous condition of its neighbour under free trade. Melbourne is so thoroughly permeated with the principles of "protection," that a Bill lately introduced into the Local Legislature permitting the construction of tramways in the very wide and long streets of Melbourne "had to be abandoned in consequence of the determined opposition of the cab-drivers, the majority of whom own the vehicles which they drive. These men argued, naturally enough, that as the manufacturing trades (of Victoria) were protected against foreigners, their business also should be protected against competition in the only form in which it could arise."

In the author's American experiences we get a glimpse of the magnificent "Palace Hotel in San Francisco, containing over a thousand rooms, and with rarely less than a thousand inhabitants." Then we are told of the journey eastwards, *via* Salt Lake City, to Chicago, in a Pullman train, life in which is said to be uncommonly like travelling in a ship over dry ground. Diverging to visit Niagara, we there hear of "the peripatetic photographer, who endeavours to persuade you that you are greater than the 'Falls.' The Falls, indeed, are made to seem a mere background to your photograph, in which the artist is careful to show you nearest the camera, and hence proportionately by far the most imposing object."

The latter part of the book contains an account of two visits to Egypt —one made before and one after the late war. Here we have a graphic description of the Suez Canal, and of the present condition of Alexandria. The "miles of ruined streets" in this famous city are the result, *not* of the bombardment, but of the conflagration originated by native ruffians.

Ordinary books of travel are notorious for the omission of just those points about which the ordinary reader would like to hear. In this respect Mr. Tangye's book supplies a distinct want. The author's personality shines out in every page, and we seem to follow him and his travelling companions as along a moving panorama. As we read the clear and incisive descriptions and racy "bits" and anecdotes which stud the pages of these "Reminiscences," we are tempted to regret that the author is a great manufacturer—he would have made such an excellent "Special Correspondent."

To Mr. Tangye's friends—and his noble qualities and good works cause them to be numbered by thousands—the perusal of this volume of travels will give great pleasure; but the book has even a wider purpose: its transparent truth and the solid information which it contains constitute it a valuable book of reference for the countries to which it relates. We are not, therefore, surprised to hear that a large first edition has been sold out in a few days. The original sketches by which the book is illustrated are clever and frequently amusing; they have been admirably reproduced by Mr. E. C. Mountfort. —W. J. H.

The Scientific Roll. Conducted by ALEX. RAMSAY, F.G.S.

THIS quarterly "magazine of systematised notes" commenced in November, 1880, and is now, we much regret to hear, temporarily discontinued for want of sufficient support. Eleven numbers have been issued, and only one more is needed to complete Vol. I.—a compact volume of some 380 pages—which will be issued to subscribers at the low rate of 10s.; names may be sent to the Editor, at 4, Cowper's Road, Acton, London, W. Taking Meteorology as his first subject, Mr. Ramsay's plan has been to give (1) a list of works, papers, etc., on the subject, classified chronologically, and (2) a resumé of the contents of each. The points dealt with in this first volume include, I., General Bibliography, and, II., Aqueous Vapour. Of the immense utility of the plan it is quite unnecessary to speak, while the manner in which it is being carried out by Mr. Ramsay is deserving of high praise. We also note, in the parts which have been published, two very able essays: one by the editor, "On the Diurnal Periodicity," and the second by Prof. E. D. Archibald, "On the Connection between Solar Phenomena and Climatic Cycles." We sincerely hope that scientists in general, and meteorologists in particular, will rally round Mr. Ramsay and enable him at once to complete the first volume of a work on which he has spent so much well-directed and patient labour.

Stanley's Familiar History of Birds. 420 pp., illustrated. New and revised edition. Price 6s. Published by Longmans, Green, and Co.

The late Bishop of Norwich, Edward Stanley, F.R.S., was a man possessing a great love for Nature, combined with scientific knowledge and accuracy. His book on birds has been, according to the publisher's preface, "revised by a practical ornithologist of much experience," but many alterations were neither necessary nor desirable, for the author was famous for his clear and admirable English, and his book contains a great mass of facts which no advance in scientific theories can ever alter. We have re-read the book, in this its new and handsome form, and we can safely say that there is no better or more interesting introduction to the science of ornithology.

The Science Monthly, Illustrated. David Bogue and E. W. Allen, London.

We have received the January number of this magazine, a new venture at the end of last year. Many of the illustrations are capital, and the reproduction of the photograph of Sir William Thomson is one of the finest we have seen of its kind. This magazine is well edited and the articles are for the most part interesting and useful..

Notes on Collecting and Preserving Natural History Objects. Edited by J. E. Taylor; 215 pages, 45 woodcuts; price 3s. 6d. Published by W. H. Allen & Co., London.

This is a new edition of a book which has had a large sale since its first publication some few years ago. Each branch of Natural History is treated by an expert—Geological Specimens by the editor; Birds' Eggs, by T. Southwell; Butterflies and Moths, by Dr. Knaggs; Flowering Plants and Ferns, by J. Britten; Mosses, by Dr. Braithwaite; Fungi, by W. G. Smith; and Seaweeds, by W. H. Grattan. Grasses, Lichens, Beetles, Bones, Hymenoptera, and Shells also have special articles devoted to the places in which they occur; how to look for them; how to secure, prepare, dry or clean individual specimens, etc., etc. This work ought to be in the hand of every student of Natural History; even the oldest collector may learn something from it, while to the beginner it will be of inestimable value, teaching him how to set about his work and how to preserve the fruits of his toil in a manner which, without such aid, he could only attain to a knowledge of by years of dearly-bought experience.

Preparation of Coal.—Having read the note on this subject in last month's issue I should like to state my experience and learn that of others. I have tried section-making of every kind of fire coal I could get, grinding as thin as it is possible, with but one result—failure. I could get no light to pass through the section. I have tried to get rid of the colouring matter but with like success. I think the difficulty lies not in getting the coal thin but in the presence of so much colouring matter. Will others state their experience?—H. Insley.

Natural History Notes.

THE GREAT COMET OF 1882.—Notwithstanding the long period during which this fine comet remained visible, great discrepancies have been made by astronomers in the calculation of its orbit, the cause doubtless being the change in form and even the multiplication of the nucleus. The latest, and probably the most trustworthy calculations—by Dr. Morrison, of Washington,—assign to the comet a period of 751 years. It is therefore identical with the comet of whose appearance we have records in 370 B.C., and again in 1131 A.D. As at one time certain astronomers were inclined to believe the comet of 1882 the same as that of 1880 and 1843, and therefore to predict its early return and possible rush into the sun, it may be some comfort to them to know that it is not again "due" till the year 2633.

IN THE JOURNAL OF BOTANY FOR JANUARY are several articles of special interest to British botanists. Messrs. Henry and James Groves give their notes on British Characeæ for 1883, in which new records are given for many of our British species. A new variety of *C. fragilis*, Desv., var. *Sturrockii*, *var. nov.*, is described, the special characters being "stem 2 to 3ft. high, very imperfectly triplostichous, spine cells tubercular, branchlets 1 to 3in. long, with all the segments ecorticate, bract cells whorled." A new species, *C. Braunii*, Gmelin, is also described, and figured. "Stem moderately stout, much branched, without spine cells, whorls usually of 8 to 11 straight or slightly incurved branchlets; stipulodes in a single circle, alternating with the branchlets; branchlets of 4 to 5 segments, the ultimate very short, scarcely exceeding the bract-cells; bract-cells at the fruiting nodes, 5 to 7, usually shorter than the nucules, nucules single or in pairs, ovate, 10 to 11 striate. Coronula short, slightly spreading, nucleus black." *Chara Braunii* was discovered by Mr. Charles Bailey, near Reddish, South Lancashire, in September last, in a canal in which the water is raised to an abnormal temperature by the hot water from the adjacent mills. *Tolypella prolifera*, Leonb., has been found in Lincolnshire by Mr. W. H. Beeby; not previously found in England since Borrer's time. Mr. J. G. Baker, F.R.S., contributes a valuable and interesting paper "On the Upland Botany of Derbyshire," in which is an account of the various elevations in that county, and a full list of the plants observed, ascending 200 yards and upwards. Over 370 plants are recorded, with the highest elevations in yards at which they were found. Mr. W. H. Beeby gives notes "On the Flora of South Lincolnshire," in which about 300 species are noticed. Of these, 26 are unrecorded for South Lincolnshire in "Topographical Botany," ed. ii. In the short notes, Mr. Frederick Townsend gives a note on "Proterogyny in *Erythræa capitata*, Willd," and Mr. Arthur Bennett, F.L.S., announces the discovery in England of *Carex Ligerica*, Gay.—J. E. B.

LOCAL OBSERVATIONS.—We have *Primula vulgaris* and *Ulex Europæus* in bloom; *Vanessa urticæ* taken in the streets, Winter Moth abundant. Young birds of Hedge Sparrow taken in our gardens. It is a grand time for pupa-digging, of which we are taking advantage.—T. J. GOLDSMITH, Nottingham, Jan. 16.

MILDNESS OF THE SEASON.—Up to the time of writing this paragraph, the winter (?) of 1883-4 has given us no frost or snow, and has been altogether abnormally mild. Wild flowers—violets, snowdrops, and primroses—are abundant; birds are building their nests—we have just heard of a brown linnet's, containing six eggs, being taken near Bedworth—and there have been many days superior in warmth and sunshine to those of the inclement summers with which we have lately been familiar. In considering the cause of the high temperature which has prevailed, we may note the unusually disturbed state of the surface of the sun, as evidenced by the numerous spots, many large enough to be visible to the naked eye, which have been noted on the photosphere during the last few months. Then it may be suspected that the conditions which have produced the remarkable sunsets referred to in our last number may also have influenced the temperature of the earth's surface. The presence of much aqueous vapour, or of matter in a finely divided form, as volcanic dust, would undoubtedly tend in this direction, as it would prevent the radiation of heat from the earth, and so act like the glass roof of a hot-house, or a cloud. Gilbert White (letter lxv.) notices that the year 1783, in which Sicily and Norway were subject to earthquakes and, the air was filled with volcanic dust (though he did not know this latter fact), was remarkable for its extreme heat. Thunder-storms abounded, wasps swarmed in myriads (letter lxiv.), and honey-dew ruined the beauties of the garden.

THE MILD SEASON IN THE FENS.—The mildness of the weather for the time of year has been unprecedented. Of winter we have had none, but the weather-wise predict a period of severity about Easter. The fruit trees are showing the forwardness of the season in an extraordinary manner, and make proprietors of orchards shrug their shoulders as they see the bursting buds and contemplate the prospect of nipping frosts ahead. The cherries are the most precocious. In one case near the town sufficient bloom might have been gathered from a cherry tree to form a large-sized bouquet, whilst there are instances of currants and gooseberries failing to shed some of their leaves at all. In all departments of the orchard the sap is rising fast; when once the sap gets active (and nothing will do it sooner than the warm muggy days lately experienced) orchardists may rely on high prices and scarcity of fruit in 1884. In the floricultural line the deceptiveness of the season is equally apparent. Violets have been plentifully plucked in the hedges during the past fortnight, and there are beds of primroses blooming in many gardens. Half-hardy plants remained in the beds in the open without so much as receiving a check. The fens are "boiling" in newly-turned grounds, as they are accustomed to do in March, whilst the animal and insect world all show decided indications of a premature season. Last Sunday, on the Dogsthorpe Road, a resident caught a fine specimen of butterfly (probably *Vanessa urticæ*), whilst the common honey bee has been roused from its dormant condition these three weeks, and may be seen settling on the opening spring flowers, both wild and cultivated. The North Bank and the meadows around are thickly sprinkled with daisies, and the wild foxglove in warm haunts is beginning to throw up flowering spikelets, and thus, in common with the whole of nature, showing the remarkable mildness of the season.—E. Wheeler, Peterborough, Jan. 17, 1884.

Notes from Woking.—The mild weather seems to have upset the insects altogether from their winter slumbers. The Blow Fly (*Musca vomitoria*) was quite plentiful on the walls and palings on December 28th, 1883, New Year's Day being danced in by small companies of the Spring Gnat (*Trichocera vernalis*), whilst the female of *Culex pipiens* and her big sister, *annulatus*, seemed to be looking about for a likely water butt wherein they might place their baskets of eggs; but like human beings, they are procrastinating, and don't seem to know whether to "go in" for another snooze, or a little human blood. Creeping up the glass on the inside of the greenhouse and windows, I noticed a large number of minute Hymenoptera, some of which no doubt had emerged from their pupæ in the various species of Green Fly, which abound on everything in a damp lean-to house. January 10th.—The sun shone out so brightly that a small Tortoise-shell Butterfly (*Vanessa urticæ*) felt compelled to come out and try its wings again, rejoicing in the glorious freedom—now alighting on the wall, basking in the warm sunshine, then with that peculiar flutter off it sailed over the tops of the houses. January 12th.—A sudden frost after six a.m., the thermometer registering 6° below freezing point; the White Dead Nettle and Hawkweed out in bloom, the lark warbling, sparrows pairing, and nature generally seems to have been called up very early.—F. Enock.

"Mental Evolution in Animals" is the title of the long-expected work by Mr. G. J. Romanes, in which he applies the data that he collected in his "Animal Intelligence" to trace the course by which mind has been evolved in animals. He found the field on which he had entered so wide that he was compelled to relinquish his first design, and hence the mental evolution of man is excluded from the present work, and will form the subject of a later treatise. The subject of instinct is treated at very great length in this volume (through nearly 200 pages), and in an appendix at the end is contained Mr. Darwin's "Essay on Instinct," to which allusion was made in our last number, and which, we forgot to mention there, was originally written to form a part of the famous "Origin of Species," but was suppressed in consequence of the merciless compression to which that book was subjected.

INFLUENCE OF THE GEOLOGICAL CONDITIONS OF A COUNTRY UPON ITS FLORA.—It is a curious and interesting fact in connection with the botany of Northern Queensland, that the country outside of what is generally known as the conglomerate is nearly always devoid of striking or beautiful plants, trees, or shrubs. Grasses abound, and the country is valuable for pastoral purposes. The conglomerate, on the contrary, is utterly useless, excepting always those portions which are auriferous. Its chief characteristic features consist of stretches of bare rock, dotted here and there by a few clumps of dwarfed trees and bushes, and occasionally crossed by patches of low, dense jungle. This tract is furrowed in every direction by innumerable creeks, which have eroded deep gorges through the soft sandstone rock. Many of these creeks have their sources underground, and flow through caves for a considerable distance before emerging into the light of day. These caves are joined together by innumerable cross passages or caves, the whole forming a perfect reticulation. But although the conglomerate is useless for pastoral purposes, it affords a marked contrast to the more richly grassed country, for we here find that every nook and dell, every creek and valley, is transformed into what I may aptly term a natural conservatory. Rare and valuable plants meet the gaze in every direction; flowers of most varied hues, from the tiniest of tiny orchids, to the dazzling spikes of the grevilleas, which form masses of bright scarlet on a dark background of dense scrub, whose walls of the most vivid green rise gradually towards the summit of the sloping wall of rock, allowing a glimpse here and there of its rich brown sides, and terminating in a broad band of shrubs some 5ft. high, which everywhere crown the edge of the cliff. The novelty of the many parasitical plants growing in the most unexpected places, the beautiful and ever-varying forms of countless ferns rearing their graceful fronds over the margins of pools, the varying tints of the mosses and lichens, the nodding grasses, and the many shades of green, combine to make up a picture which cannot be surpassed for loveliness in Australia. Of course this wealth of plant-life is entirely owing to the abundance of water, and to the great heat generated by the sandstone rock. Every few steps you pass the mouth of a cave, sometimes a mere hole, and again a glorious arch thirty or forty feet high, leading into a tunnel, where a drink of ice-cold water can always be obtained. These cave-openings can be seen high up in the sides of the cliffs. Bats, snakes, the rock-wallaby, and a host of birds make their homes in the sombre depths of these natural chambers. Daylight often struggles in through a rift in the ceiling, through which also the water percolates. Now and then you pass the mouths of others, and obtain glimpses into the fairy-like depths of their botanical treasures. But when you reach the summit and step out of the narrow strip of jungle on to a stretch of bare rock, you gaze at a scene the sterility and loneliness of which strikes you as the very antipodes of the paradise you have left below.—From "The Australasian," by Capt. W. E. Armit, F.L.S.

NITELLA, AND FLINT IMPLEMENTS.—In the fall of 1882, Mr. J. Saunders, of Luton, discovered *Nitella mucronita* in a pond at the end of the Ouse embankment, Bedford, but during the summer scarcely a trace of the plant could be found. Mr. W. Davis, however, has just re-discovered it in a locality nearer the town. A few weeks since I found a perfect specimen of a flint axe-head in gravel, which came from the river deposits at Kempston. These beds were investigated by the late Mr. Wyatt, F.G.S., who discovered several flint implements therein, and they belong to the same series as the implement-bearing gravels of Biddenham, which are represented in Lyell's "Elements of Geology," by fig. 86, giving a section across the valley of the Ouse, two miles west-north-west of Bedford. Several of Flint Jack's productions are still extant in Bedford, but I have found, on comparison, a marked difference between his handicraft and the genuine specimens. Some months ago Mr. Harrison inquired through the columns of "Knowledge" what had become of Flint Jack. I am informed that he was committed to Bedford gaol for stealing a clock, and that he died while an inmate of that institution.—J. H. HAMSON, Bedford.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—January 8th.—At a specially summoned General Meeting, the Committee of this Society recommended an alteration of the rules which has been long under consideration, by which the annual subscription of ordinary members is raised to one guinea. This recommendation was proposed by the President, Mr. T. H. Waller, and seconded by the Vice-President, Mr. R. W. Chase, and after a discussion, in which it was supported by Messrs. Levick, Wills, Hughes, Hillhouse, and others, and opposed by Messrs. Woodward and Barrett, on the ground that the augmented expenditure, to meet which the increase was made, was unnecessary, the resolution was carried by a large majority. Several other changes of the laws, involved in the the foregoing, were then carried. Under the new arrangement the privileges of members will be greatly increased, and the Society will be consolidated. It was also provided that resident members of the family of a subscriber may, on payment of half a guinea, be entitled to most of the privileges of membership.—SOIREE, January 22nd.—The President, Mr. T. H. Waller, in the chair. The evening was chiefly devoted to the exhibition of microscopic objects, among which were the following:—Mr. W. P. Marshall, a section of an excreting gland on the edge of a Saxifrage leaf, showing the excreted lime deposited at the discharging orifice; Mr. T. H. Waller, section of Perthite (felspar) and Microcline felspar, showing the characteristics of these minerals; Mr. W. R. Hughes, section of sponge, "Venus's Flower Basket," showing the strengthening spicules *in situ;* Mr. W. H. Wilkinson, a lichen (*Cladonia*) from the Scotch Highlands, showing the brilliant scarlet fructification; Mr. W. Graham, a Sertularia, showing the zoophytes with extended tentacles; Mr. H. Miller, *Pleurosigma formosum*—a marine diatom—showing the striations; Mr. F. Derry, the "Fairy fly," a species of *Hymenoptera;* Mr. W. H. Bowater, transverse section of oak, stained, mounted by himself; Mr. R. M. Lloyd, the palate of *Succinea putris;* Mr. C. T. Parsons, the carmine Peziza, a beautiful fungus, on a twig; Mr. W. B. Grove, the fungus on mouldy bread; Mr. J. Morley, a fine specimen of *Leptodora hyalina*, mounted in pure spirit. Mr. R. W. Chase also exhibited three birds—the Little Auk, from the Faroe Islands; the Reeve, from Ireland; and the Grasshopper Warbler, from Frankley. A large number of photographs of the earthquake at Ischia were also exhibited, by permission of Mr. Paxton Porter.

BIRMINGHAM AND MIDLAND INSTITUTE SCIENTIFIC SOCIETY.—December 12th.—Mr. A. H. Hiorns read a paper on the "Basic Bessemer Process." Among the methods of refining iron in open vessels, the most important is that patented by Mr. Bessemer in 1856, which has had so large a development in late years. It consists of blowing air through molten pig-iron so as to burn off the carbon, silicon, etc., leaving the iron in a malleable condition, or sufficient carbon to form steel. This was a great advance on the old method of refining in reverberatory furnaces, called puddling. In the latter, only about one hundred-weight is operated on at a time; in the former several tons, and in a much quicker time. The early apparatus was a closed vessel, with only one communication with the atmosphere by means of a curved opening. This was afterwards modified into a pear-shaped vessel with a large open mouth inclined to one side. At the present time concentric vessels are used with a wide mouth and straight neck, which prevents the metal from sticking to the neck as in the eccentric form. Originally two or three tons were operated upon at one time; now ten to fifteen tons is a usual quantity. The Bessemer converter has an acid lining formed of ganister, which prevents the elimination of phosphorus. In 1872 Snelus showed that the retention of phosphorus was intimately related to the slag. When the slag is highly basic, as in puddling, the phosphorus goes into the slag. He substituted dolomite bricks for the ganister lining, and proved that steel could be made from pig-iron containing 2 per cent. phosphorus, and the phosphorus be reduced to 0·1 per cent., but these results were not published. Messrs. Thomas and Gilchrist, after a series of experiments, prepared a paper to be read before the Iron and Steel Institute in 1878, and it is to their skill and perseverance, in conjunction with Mr. W. Richards, that the Basic process has achieved a technical and commercial success. They at first made bricks of Magnesian limestone like Snelus, but encountered great difficulties on account of the enormous shrinkage of the limestone. The lining is made of calcined and crushed dolomite, mixed with tar and rammed round a core which is afterwards removed. From 15 to 25 per cent. of lime is charged in with the iron according to the amount of silicon in the pig. By this means the phosphorus is almost completely removed. It is a noteworthy fact that while in the Bessemer process the pig must be siliceous and contain very little phosphorus, with the Basic process the reverse is the case; so that if the pig in the latter process does not contain 1½ to 2 per cent. of phosphorus, that element is added as ferro-phosphorus. Also in the Bessemer process gray iron is necessary; in the Basic process white iron is much preferred. The lining is not so durable in the latter as in the former, and a much greater amount of slag is formed, which increases the loss of iron and diminishes the useful effect by one fourth to one third. In both methods the refining is carried on till the iron is malleable, and the necessary amount of carbon added in the form of Spiegel-eisen or ferro-manganese. An essential feature in the Basic process is the successive stoppages for test samples, which prolong the operation. There is also uncertainty of sufficient dephospori-sation. One point more of very great importance remains to be noted. The phosphorus is very little affected as long as any carbon is present, so that an "after-blow" is necessary to remove the phosphorus. Now, on adding the ferro-manganese some of the phosphide of iron in the slag is reduced by the carbon monoxide liberated, so that the amount of phosphorus in the final product is greater than in the malleable metal at the end of the ordinary blow. Therefore the great desideratum of the Basic process is avoidance of the after-blow, which at present is essential.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—This Society has removed its place of meeting to more commodious and central premises, 20, Paradise Street, next door but one to the Midland Institute. On the opening night, January 21st, a "Special Microscopic Exhibition" took place, when a good show of instruments was made. The exhibits were chiefly living organisms, and proved very interesting to those present. Meetings are held every Monday evening at 7.30, when the attendance of all interested in natural science is earnestly invited. As the Society was formed solely to promote a love for natural objects all students and lovers of Nature who may visit its rooms will be sure to meet with a cordial welcome.

CHELTENHAM NATURAL SCIENCE SOCIETY.—December 20th.—Mr. H. Matthews delivered a lecture on "The Optical Characters of Crystals," which was beautifully illustrated by experiments. Beginning with a general idea of wave motion as derived from the observation of the disturbance created in a still pond by throwing in pebbles, he passed on to the motion of the luminiferous ether, and then to double refraction. The action of a pair of Nicol's prisms was then illustrated, and the effect of introducing between them a plate of selenite. A curious effect was produced by splitting the selenite thinner and thinner, while still holding it between the prisms; as the thickness of the slices was very variable, a gorgeous display of colour was obtained. After explaining the theory of the production of these colours, the lecturer placed a thin film of liquified benzoic acid between the prisms; no colour was produced, but as it cooled crystal after crystal was formed, and their images flashed on the screen in brilliant hues. Mr. E. Wethered exhibited the sporangia of carboniferous plants from the lower limestone shales of the Forest of Dean, which were similar to those found in the black shales of Ohio, from which oil is derived.

NOTTINGHAM NATURALISTS' SOCIETY.—January 15th.—Mr. J. S. Hedderley read an instructive paper by Capt. Becher, R.A., of Southwell, entitled "About Birds." At the conclusion of the paper an interesting discussion followed, in which Messrs. Wheatley, Blandy, Musson, and Hedderley took part. The Annual Meeting of the Society was held on Tuesday, January 8th. The President, Dr. E.

Seaton, occupied the chair. The proceedings were commenced by the Hon. Secretary, Mr. B. S. Dodd, reading the annual report of the Committee, of which the following is an abridgment:—The Committee with great pleasure recorded a considerable increase of members during the past year, 69 ordinary members having been added to the Society, besides 6 corresponding members who reside at a distance. The membership stood thus: 5 honorary, 133 ordinary, and 7 corresponding members, making a total of 145. The Committee has been enlarged so as to make it more widely representative. They were endeavouring to secure a larger and more convenient meeting place on account of the increased membership. During the summer excursions had been made to Burghley House, Lincoln, and Dovedale. During the year nine papers and eight short communications of considerable interest and merit had been read before the Society, and had been followed usually by discussion. The Committee has arranged that in future all papers read before the Society, after being printed by the local press, should be printed from time to time to form the yearly volume of the Society's transactions. The lending library had been very successful, 70 volumes having been in circulation since its opening in April last. During the year the library had been augmented by the purchase of 20 interesting works, and still further by the generous gift of the late members of the G.R.S. Naturalists' Society of some 30 odd volumes. The annual dinner was announced to be held on February 7th at the George Hotel, and the annual soirée some time in March. After the rules of the society had been revised, the meeting proceeded to elect the officers and committee for the ensuing year, Dr. Seaton being re-elected president, and the meeting closed with the usual vote of thanks to the chairman.

NOTTINGHAM WORKING MEN'S NATURALIST'S SOCIETY. —January 7th.—An entertainment, called "A Peep at Nature through the Microscope," illustrated by dissolving views, was given by Messrs. Jepson and Goldsmith. The subjects treated of were Parasites of various kinds, Botany, Geological Sections, and Soundings from H.M.S. "Challenger." This Society usually devotes the evening of the first Monday in the month to a scientific exhibition, free to the public.—T. J. Goldsmith.

PETERBOROUGH NATURAL HISTORY AND SCIENTIFIC SOCIETY.—Gilchrist Lecture, Jan. 17th.—The first of a series of six lectures of the "Gilchrist Educational Trust" was given in the Drill Hall, Peterborough, under the auspices of this Society. For some time previously Mr. R. A. Procter was announced for the opening lecture, which was to have been upon the fascinating subject, "The Birth and Death of Worlds," but owing to indisposition he was unable to fulfil the engagement, and Professor Robert Ball, LL.D., F.R.S., Royal Astronomer of Ireland, lectured on "The Telescope and its uses." There was a large audience. The lecture, which was illustrated by views thrown upon a screen by a powerful lime light, was given in a popular and interesting manner. It first dealt with the human eye and how it was aided in the attempts to see faint celestial objects by the telescope, the use of which was an equivalent to an enlargement of the pupil. The early attempts to construct a large telescope were described, and the present monster one at Vienna was illustrated. Lord Rosse's great telescope and various kinds of the same instrument were shown upon the screen, followed by a photograph of the moon and observations thereon. The arctic regions and the wonderful canals discernible in Mars were demonstrated, as well as the peculiarities of the planet Saturn as seen by a telescope. Comets were touched upon, as also the sun and his system, our sun, the lecturer remarking, being only one of 50,000,000 suns. The whole of the heavens was reviewed by the telescope, and the lecturer concluded by a peroration on the infinity of space. The next lecture will be on the "Animals of the Coal Period," by Professor Miall, F.G.S.—E. WHEELER.

OUR SUB-EDITORS.

Mr. E. WHEELER, 45, Cromwell Road, Peterborough.

Mr. T. J. GOLDSMITH, 7, Colsterworth Terrace, Glebe Street, Nottingham.

Mr. J. HAMSON, Spring Road, Elstow, Bedford.

Mr. J. W. NEVILLE, Wellington Road, Handsworth.

Rev. T. FOSTER ROLFE, Glascote, Tamworth.

Mr. J. O'SULLIVAN, Stapenhill, Burton-on-Trent.

Mr. THOS. W. CAVE, M.R.C.V.S., Broad Street, Nottingham.

R. H. LAW, ESQ., Copthorne House, Shrewsbury.

OUR METEOROLOGICAL COLUMN.

The first three volumes of the "Midland Naturalist" contain tabulated meteorological returns from about sixty stations in the Midlands, with remarks on the weather of each month; the whole being edited by Mr. W. J. Harrison, who was then in charge of the meteorological instruments belonging to the Leicester Museum. On Mr. Harrison's removal to Birmingham the work was continued for more than two years by Mr. Clement L. Wragge, whose work in connection with the observatory on Ben Nevis has made him so generally known. Mr. Wragge left England last year in order to continue his observations abroad, and our meteorological column was temporarily discontinued. We have now much pleasure in announcing that Mr. Wm. Berridge, F.M.S., of 12, Victoria Street, Loughborough, has consented to act as sub-editor for meteorology, and we earnestly ask all who are interested in that subject to send their observations to him monthly, in order that he may be supplied with the material for a resumé of the atmospheric conditions of the Midlands. It is not Mr. Berridge's intention to revive the old "page of figures;" the statistics formerly so given are now printed elsewhere—in the Meteorological Magazine, the Proceedings of the Meteorological Society, the publications of the Government Weather Office, &c.—where experts can refer to them, while in our columns they were "caviare to the general." Still Mr. Berridge will be thankful to receive all such information, and will work it up with such notes on the connection of plants and animals with atmospheric phenomena, &c., as he may receive. We consider ourselves fortunate in securing the services of so able and accurate a meteorologist, to act as a sub-editor. Mr. Berridge has lately been appointed Observer to the Meteorological Department of the Board of Trade, and Loughborough now supplants Nottingham as one of the centres yielding information from which the Daily Weather Charts are prepared.

ON THE INTERCELLULAR RELATIONS OF PROTOPLASTS.*

BY WILLIAM HILLHOUSE, B.A., F.L.S.,

SCHOLAR OF TRINITY COLLEGE, CAMBRIDGE, PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY, MASON SCIENCE COLLEGE, BIRMINGHAM.

INTRODUCTION.—[ABSTRACT.]

During the past few years the one preponderating study in which vegetable physiologists have been engaged is the elucidation of the internal phenomena of the vegetable cell. Since the time when Schleiden first suggested that in the study of the life-history of the individual cell we should find the true basis of the study of plant life, von Mohl published in Wagner's "Handwörterbuch der Physiologie" an account of its structure and life-history,† and Hofmeister gave to the world his far broader and more incisive work,‡ the ball has rolled on apace, gathering vigour as it has proceeded, until now at length we appear to be within arm's length of some grand generalisation. The mass of facts which within recent years has been brought together by a host of observers, pre-eminent amongst whom, in this department, stands Strasburger, the gifted author of the modern conception of vegetable embryology, is simply incredible. What is now needed is someone who shall collect these masses of isolated phenomena and weld them into one organic whole, who shall do for this decade what von Mohl and Hofmeister did respectively for theirs.

One by one the old conceptions of vegetable life have given way to the new; the barriers which have apparently isolated the vegetable from the animal world have been broken down. It is but a few years since botanists were taught that the cell was everything; in modern teaching the vegetable organism is a whole, with its protoplasmic body, it is true, broken into fragments which show apparent isolation, but which, nevertheless, show clear co-ordination. To the acceptance of this view Sachs, by far the greatest of modern vegetable physiologists, has mainly conduced. And now it appears as if another line of demarcation is to be wiped out,

* Transactions of the Birmingham Natural History and Microscopical Society. Read December 4th, 1883.

† "Grundzüge der Anatomie und Physiologie der vegetabilischen Zelle" (1851).

‡ "Die Lenre von der Pflanzenzelle" (1867).

and the anatomical isolation which has been ascribed to the vegetable cell is also to be shown to be but a partial truth, if, indeed, it be a truth at all.

The vital basis of the plant-cell is its protoplasm, a name given to it by von Mohl in 1851. So long ago as 1863, Max Schultze showed* that vegetable protoplasm and animal sarcode† are one and the same thing. To this identic substance Huxley has given the very happy title of the "Physical Basis of Life," while Dr. Lionel Beale has suggested the somewhat broader name of Bioplasm to be applied alike to animal and vegetable protoplasm. Living, it possesses alike in animal and vegetable form certain special characteristics—assimilative and constructive energy, spontaneous motility (contractility), water absorptive power, and coagulability with various reagents; while dead it has cumulative action with staining matters.

Exactly like, then, as animal and vegetable protoplasm fundamentally are, the vegetable cell, in at least all except its most primitive forms, has been by biologists looked upon as a thing *sui generis*, in having the property of closely investing itself with a wall, secreted by the activity of its own protoplasm, a wall carbohydrate in its chemical nature, closely analogous with starch, a "cell-wall" of cellulose, as it is called, by which each particle of protoplasm has imprisoned itself and cut itself off from contact, and thereby, apparently, from close physiological connection with its neighbours; a wall, by diffusion through which, except in a few well-marked cases, was the only method of the intercommunication of cell-contents; a wall, which acts towards the individual cell as an exoskeleton, in a manner analogous to the chitinous envelope which invests the bodies, etc., of the insecta. Even the possession of a cell-wall is not, however, exclusively a vegetable function. Fat cells and epithelial cells have an external investment, totally unlike, however, that of the plant-cell, while Bergh has recently shown that in the *Cilio flagellata* a cell wall much more closely resembling that in plants is present.

The greater part of our knowledge of protoplasm in its relations with the cell-wall has been derived from the study of protoplasm in its contracted state. At all times, and especially so in cells which are actively growing, the protoplasm

* Schultze, "Ueber das Protoplasma der Rhizopoden und Pflanzenzellen."

† Sarcode.—Name given by Dujardin in 1835 to the contractile, structureless, semi fluid substance which forms the body of many of the lowest members of the animal kingdom.

contains a considerable, and often very large, percentage of water. Under the influence, as it is usually stated, of this aqueous content the protoplasm is kept in an expanded state, closely applied to the inner side of the cell-wall, and pressing upon it. This pressure, under the name of "The Mechanical Theory of Growth," has been looked upon, from the teaching of Sachs, as the great cause of the increase in size of the cell.* Under the influence of various water withdrawing media the water can in part, though never altogether, be withdrawn from the protoplasm, the latter then contracting to one side of the cell. This phenomenon, known to all observers for at least the last thirty years, had been the origin of the name "primordial utricle." The outer layer of protoplasm, in contact with the cell-wall, Pringsheim† had, so early as 1854, shown to be differentiated from the inner portion, and had given to it a separate name. In its contracted state Pringsheim had shown that sometimes at least the protoplasm remains attached to the cell-wall by protoplasmic threads,‡ and had figured them. Nägeli§ had observed the same phenomenon as the result of the contraction of the protoplasm under the influence of sugar solution, and had figured it especially well in the case of cells in the petals of *Dentaria digitata* (Taf. ii., fig. 5) and of *Spirogyra alpina* (Taf. iii., fig. 5), in which the threads go only to the end walls, while in other cases (Taf. iii., fig. 12) the threads are branched. It is to Hugo de Vries, however, that we owe the most extended researches‖ into the phenomena of protoplasmic contraction under the influence of salt solutions, to which contraction he gave the name of *Plasmolysis*. Using as water-withdrawing (or plasmolytic) solution sugar, solutions of various salts, especially of saltpetre and common salt, he carefully described the effects not only on the protoplasm but also on the cell-wall. Of all salts he found solutions of common table salt to be the best. Varying in rate with the strength of the solution, de Vries found that when under the influence of the salt the watery cell sap was withdrawn, the protoplasm contracted away from the cell wall (this latter also shrinking) into a rounded lump, which he always describes and figures as lying free in the cell-cavity, or only

* I shall have occasion later to discuss the sufficiency of this cause.

† Pringsheim, "Bau und Bildung der Pflanzenzelle," 1854, p. 4.

‡ Pringsheim, l.c., Taf. iii.

§ Nägeli, "Pflanzenphysiologische Untersuchungen," von Nägeli und Cramer, 1855.

‖ De Vries, "Unters. über die mechan. Ursachen d. Zellstreckung," 1877.

adhering by a part of its periphery to the cell-wall. Its free margin, that is, the boundary of its external differentiated layer, the ectoplasm, he describes as of smooth unbroken outline. On removal of the salt by pure water the protoplasm will, sometimes even after several days remaining in the plasmolysed state, gradually reabsorb, and resume its old place applied to the cell-wall.

Apart from the previously known cases mentioned above, and the striking phenomena uniformly present in many tissues, which will be illustrated in a subsequent section of this paper, the light which has within the last two years been thrown on the actual origin of the cell-wall would in itself predispose to doubt on the subject of this apparent freedom of the cell-wall from firm attachment to the protoplasm whence it derives its origin. The theory of intussusception, as accounting for the growth in extent and thickness of the cell-wall, has, in the opinion of most physiological botanists, to be more or less completely abandoned in favour of the older theory of apposition, now reaffirmed by Schimper, Meyer, Strasburger, Schmitz, von Höhnel, and others. The position especially maintained by Strasburger* and Schmitz,† that the cell-wall is formed and thickened by protoplasmic granules, called by the latter *microsomata*; and the opinion expressed by the former (l. c., p. 174) that cellulose is formed by the direct splitting of protoplasm,‡ greatly enhance the interest of this question. We cannot help asking ourselves (1) Do any of the protoplasmic threads which connect the poles of nuclei in process of division, and in (or on) which the elements of the cell-plate are formed, persist after the formation of the partition wall? and (2) If the microsomata more or less bodily pass over into the substance of the cell-wall, is there thereby established a more intimate subsequent connection than de Vries' researches would suggest between cell-wall and protoplasm?

An interesting contribution to the knowledge of the relations between the cell-wall and the protoplasm it encloses, as illustrated in the phenomena of Plasmolysis,

* Strasburger, "Ueber den Bau und das Wachsthum der Zellhäute," 1882.

† Schmitz, "Sitzbr. der niederrh. Gesell. für Natur-und Heilkunde in Bonn," 6th Dec., 1880.

‡ "Die Beobachtungen über Scheidewandbildung zeigen aber, sobald die Natur der Zellplattenelemente als Mikrosomen erkannt ist, auf das Bestimmteste die Bildung der Cellulose durch directe Spaltung des Protoplasma."

is that of F. O. Bower.* Using as plasmolysing agent solutions of common salt, from one to ten per cent., so largely used by de Vries (l.c.), Bower shows that in a great many cases the contracted protoplasm of parenchymatous cells remains connected with the cell-walls by strings of great initial tenuity, often only after some interval, and commonly slowly, thickening. In the prothallus of *Nephrodium villosum* and *Aspidium Filix-mas* a two per cent. solution causes contraction of the protoplasm into a rounded mass, showing usually the smooth outline of de Vries. Later appear, however, delicate radial striation from the protoplasmic body, striation gradually extending itself to the cell-wall, while the striæ gradually become more definite and resolve themselves into protoplasmic strings passing from protoplasm to cell-wall. Sometimes these strings are present from the first. In the coarser threads are often shown nodal thickenings. The increase of thickness of the threads Bower suggests may either take place from a supply of new material from the protoplasmic mass, or by lateral coalescence of the threads. Slow movement of the nodal thickenings away from the protoplasmic mass suggests the occurrence of the former; the vibratory motion which the threads acquire after a time, showing diminution of their tension, supports this view, while the author has no evidence to show, though he admits the probability of, the occurrence of lateral coalescence of neighbouring threads.

These observations the author confirms on various plants; in the young flower stalks of *Cephalaria rigida* (allied material to that used by de Vries), leaves of *Vallisneria spiralis*, and of many other aquatics. In the prothalli above mentioned he had found that the threads ran equally to the free walls of the cells, and to those adjoining other cells; this he confirms in the internal cells adjoining intercellular spaces in *Pontederia cærulea*.

All the above plants have approximately smooth-walled cells, and the author further proceeds to examine the cells of the fronds of two species of *Trichomanes*, in which the walls are pitted, in order to see if any relation exists between the protoplasmic threads and the pits. In the cells of these plants he found the threads equally to run to the unpitted free walls and the pitted lateral walls, and that though protoplasmic threads do run to pits, and threads from the

* F. O. Bower, "On Plasmolysis and its bearing upon the relations between cell-wall and protoplasm." Quart. J. Mic. Science, 1883 (Jan.), pp. 157-67, and plate VIII.

neighbour cell run to the equivalent pit in its wall, these are, however, the exception. The author's observations therefore fail to show any special relation of the protoplasm to the pits. In his concluding remarks he suggests two possible explanations of these phenomena:—"(1) That the main mass of protoplasm on retreating may leave the cell-wall still completely lined with a thin film of protoplasm; (2) that the peripheral part of the protoplasm being entangled, as a network, among the deposited microsomata, may, on the contraction of the main mass, be drawn out at the points of entanglement into fine strings like those observed, while the surface of the wall is for the most part left free." To the second of these views the author leans.

(To be continued.)

METEOROLOGICAL NOTES.—January, 1884.

A raw, easterly wind, on the 1st, seemed to indicate a period of cold weather, but the wind soon veered to southward, and the temperature continued relatively high to the end of the month. The barometer was unsteady at the commencement of the month, with a downward tendency; after touching 29·72 inches on the 6th, it rose by a succession of jerks to 30·62 inches on the 16th. From the 21st the mercury fell rapidly till the 23rd, when a sudden rise was succeeded by a fall, most unusual in its depth. At 6 p.m. on the 26th the corrected readings were:—at Loughborough, 28·377 inches; at Strelley, 28·322 inches; at Hodsock, 28·293 inches. This very low reading was accompanied by gales, much lightning, and squally showers of rain and hail. A rapid rise succeeded, but at the close of the month the mercury was unsteady. Temperature was very uniform; air-frosts on only one or two occasions. A minimum of 30°.0 was recorded at Coston Rectory on the 16th, while a maximum of 54°.5 was registered at Hodsock on the 22nd. The mean temperature was consequently high, 5° to 6° above the average, and 15° higher than that of January, 1881, in which month the mean of maxima was 4° lower than the mean of minima of the past month. The rain-fall was rather higher than the average, the falls of snow few and slight. Sunshine was very deficient, and the atmosphere was generally cloudy and misty. Strong winds prevailed through the month, and gales were experienced from the 22nd to the 26th. Lunar halos were observed at Loughborough on the 7th and 10th. The mildness of the season caused a premature development of vegetation, and it was by no means uncommon to find spring flowers blooming in what should be midwinter. A continuance of mild weather through the spring may be favourable to the crops, but late frosts will assuredly be particularly injurious.

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NOTES ON THE TERNS BREEDING AT THE FARNE ISLANDS.*

BY R. W. CHASE.

A visitor to the Farne Islands is at once struck with the immense number of birds upon them, especially during the breeding season, and his attention is immediately drawn to them instead of being attracted by the rocky aspect and wild grandeur of the Isles themselves. Amongst various species the Terns are not the least conspicuous, as they circle and swoop over an intruder's head, uttering their shrill cries incessantly, and it is to this family that I shall confine my remarks upon the present occasion. I have visited the Farnes several times during the breeding season, and in different months, so that I might have an opportunity of watching the habits of the Sterninæ as far as possible during the whole period of raising their young.

Four species of the genus Sterna may be considered as visiting these islands annually, viz.: *S. fluviatilis*, the Common Tern; *S. hirundo*, the Arctic Tern; *S. dougalli*, the Roseate Tern; *S. cantiaca*, the Sandwich Tern. The habits of all these are in some respects similar, but upon close observation a considerable difference may be discerned, even between such closely allied species as *fluviatilis* and *hirundo*, which were considered for years to be one and the same bird, and the eggs of which it is impossible to pick out with certainty, unless you verify them by snaring the old bird on the nest.

The principal breeding station of *S. fluviatilis* is on the "Wide Opens," where in some places the eggs are so thickly placed that it requires care not to step upon them. The nest is a slight hollow scratched by the bird and lined with stalks and roots of dead herbage. I found the favourite situation to be at the top of the rock where it is grassy and nearly covered with Sea Campion (*Silene maritima*) some distance from the shore. The eggs are either two or three, more generally the latter number, I believe, and vary much in colour, from pale blue with few markings, to an olive-brown ground, well covered with dark-brown blotches.

In some nests the eggs are very dissimilar to each other, but I have specially noticed that when the nest contains three

* Transactions of the Birmingham Natural History and Microscopical Society. Read at a Meeting, January 29th, 1884.

they are usually alike both as regards size, shape, and colouring. I have not been able satisfactorily to ascertain the exact time of incubation, but think it is about sixteen days. The young as soon as they are hatched creep in amongst the Sea Campion for shelter, and you might often wonder what had become of the young birds, unless you knew where to look for them.

The principal breeding place of *S. hirundo* is the "Knoxes," an island formed of water-worn boulders and shingle, with fine sand in the centre, and entirely destitute of vegetation; also the Wide Opens and the "Northern Ears," which last is only bare whinstone, with sand thrown upon it in patches; a few pairs only form this colony.

The nest is merely a slight hollow scratched by the bird in the shingle or sand without the slightest signs of any lining; a favourite site being just above high water mark on the pebbly beach. The eggs are two in number (rarely three), usually very dark in ground colour and markings. I have never verified a nest with three eggs as belonging to *S. hirundo;* all those with that number have turned out to belong to *S. fluviatilis.*

My observations have led me to the following conclusions concerning the difference between *S. fluviatilis* and *S. hirundo.* In the adult bird, *S. fluviatilis* is lighter in colour, especially on the breast, and slightly larger; the tarsus is longer, and this mark of distinction I hold to be an infallible test, and discernible in all stages; the wings also extend beyond the tail; while in the case of *hirundo* the reverse occurs. The nest of *fluviatilis* has a slight lining and is placed generally amongst some kind of vegetation, and some distance from the shore, the number of eggs being frequently three; whereas the nest of *hirundo* has no lining and is usually placed amongst stones and shingle, often only just out of reach of the tide, the number of eggs being usually two. The young of these two species differ little when first hatched except that those of *hirundo* are darker and have a smutty appearance.

The method I adopted to verify the eggs was to snare the old birds at the nest, which can easily be done; and after determining the species I liberated the bird, as the mode of capture does not injure it in the least. Some years ago, when I wanted specimens, those so caught were killed, and five-sixths of them upon dissection proved males, clearly showing that in the Sterninæ the male assists in incubation, at all events during the day.

S. dougalli, the most beautiful and graceful of all the Terns, occurs in small numbers, associated with *S. fluviatilis* and *S. hirundo.* I cannot say for certain that it breeds on the Islands, as it would be simply a matter of chance to snare a Roseate Tern at a nest, when there are hundreds of nests around, but that it does occur at the Islands regularly I am sure; and although a note was published in the "Zoologist" for November, 1881 (p. 470), throwing doubt upon a previous communication (p. 423) affirming the occurrence of this species, I can positively state that *S. dougalli* did occur in 1881—for the best of all reasons, viz., that I have specimens in my collection obtained at the Farne Islands in that very year. On June 21st, 1883, I distinctly saw three of this species amongst the Terns upon the Wide Opens. You can easily distinguish them from *fluviatilis* and *hirundo* by their more graceful form of flight, as they wheel with almost motionless wings, by their keeping at a greater altitude, by their white appearance, long tails, and less size, and by their note, which somewhat resembles a shrill bark repeated rapidly. The beautiful pink blush upon the feathers fades considerably with death, and a stuffed specimen if exposed to light will nearly lose all trace of it.

Of *S. cantiaca*, the chief breeding place is on the Knoxes, where a large colony has bred for many years. Last year a few pairs began laying on the Northern Ears, owing, in the opinion of the lighthouse keepers, to the colony at the Knoxes being disturbed for a few days by a large falcon, probably a Peregrine. The Northern Ears, thus selected by the birds which forsook their nests at the Knoxes, was formerly a regular nesting place of this species.

It is characteristic of *S. cantiaca* that it resents interference, and if much disturbed the birds will forsake their eggs and move to a fresh locality in the hope of being left in peace.

Macgillivray, quoting Selby, states that "the eggs are placed in a shallow hole scratched amongst the Sea Campion and other plants that may happen to grow on the selected place;" this is not exactly according to what I have seen. The eggs, usually two, sometimes three, are placed in a slight hollow upon fine sand, and upon sand only, not coarse shingle, with no sign of vegetation near. In one case on the Northern Ears in June last I saw a nest containing four eggs, but in my opinion in this instance two birds had laid in the same nest. A great difference occurs as regards colour and markings on eggs found in the same nest.

In an exposed situation, such as I have endeavoured to describe, they rear their young, feeding them principally upon sand eels. The feathers of this species have a beautiful satiny appearance upon the neck and breast, and in some cases if you lift the feathers you will perceive a pink tinge, almost as vivid as in *S. dougalli*.

The Terns arrive about the middle of May, a few at first, afterwards the main body, Common, Arctic, and Sandwich, all together. After flying for hours together over the usual breeding stations without settling, they take themselves out to sea, and you can often see flocks resting upon the water. I remember in May, 1881, being afloat very early one morning, passing a great number so resting, and a very pretty sight it was; this behaviour goes on for a few days, when the birds "take the islands," as the lighthouse keepers term it; that is, they rest a greater part of the day upon the stations chosen, and roost there, after which they at once begin laying. Their departure takes place about the middle of September, after which not a single tern is to be seen, whereas a month earlier the air was thick with their wheeling flocks, and the ear almost deafened by their shrill and incessant cries.

RICHARD MOSLEY LLOYD.

It is our painful duty to record the death of an old and valued member of the Birmingham Natural History and Microscopical Society, Mr. Richard Mosley Lloyd, who for many years has been a warm supporter and active worker and officer of that institution. He died at his residence, Spring Hill, Birmingham, on Saturday, February 16th, after a few days' illness.

Mr. Lloyd will be remembered by conchologists as having added two new and well-marked varieties to the British molluscan fauna, viz., *Paludina vivipara*, var. *atro-purpurea*, and *Planorbis glaber*, var. *compressa*, as also by his contributions to various natural history publications. Of late he had given more attention to microscopic work in connection with the above Society, where, as a painstaking and obliging officer, his loss will be much felt.

All who knew him will lament the loss of a warm-hearted and honest man, kind, indulgent and forbearing, simple-minded, yet clever in much of this world's knowledge, never obtrusive, ever ready to do a kind action, not seeking reward.

The writer, to whom he was a constant companion for more than twenty years, mourns the loss of a true, gentle, and genuine friend, and his sorrowing family a tender guardian, whose care was always for the welfare and happiness of those he loved, and who never spared himself in doing that which he thought worthy of his hand.

For many years Mr. Lloyd was one of the engineers to the Water Department of Birmingham, an office he held at his death, and wherein his upright character made him much respected.

February 21, 1884. G. S. T.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER II.,

BY ALFRED HILL, M.D., F.I.C.

The Actions of Forces on Organic Matter.

The various forces which affect organic matter are heat, light, mechanical force, quasi-mechanical force as seen in the absorption of water and osmose, chemical affinity, and indirect chemical action or catalysis. The increased molecular vibration and consequent assistance rendered to the action of the other incident forces which are occasioned by the influence of heat are noticeable, and the more direct results of heat are exemplified by the evaporation which it occasions, one result of which is that circulation is started in the tissues of plants and animals, as seen in the withering of a plant whose roots are lacking sufficient moisture. The effect which light has on mineral, vegetable, and animal forms of life is obvious. As evidence of the compound character of a ray of light attention is directed to the fact that it is the yellow or luminous portion of the ray which affords the plant the opportunity of decomposing its mineral food and of fixing the hydrogen and carbon in its tissues and secretions. A consideration of the undulatory theory of the nature of light furnishes an explanation of the manner in which these changes are considered to be effected. One thing, however, is clear beyond doubt, and that is that light is absolutely necessary for the production of chlorophyll, the colours of the flower petals, and other similar results too numerous to state. The importance of the quasi-mechanical forces is shown in the absorption of water, and the introduction with it of the agents of chemical change, as well as in the conveying away of the products of such change. The physical phenomenon termed *osmosis* is one to be explained at length, as well as its instrumentality in contributing to the work of redistribution in organised bodies. The most important force, however, is *chemical affinity*, the part which oxygen performs in this character being very important. Ordinary chemical action must be compared with indirect chemical action or catalysis, so that we may have a clear conception of the peculiar nature of the latter as exhibited in the action of diastase in germination, of yeast in fermentation, of the vinegar plant in acetification, and of the production of prussic acid by the action of synaptase on amygdalin. In conclusion, attention may be drawn to the vast difference between plants and animals in the amounts of nitrogen they contain, proving that, if the functions of the former are not to cease, light is absolutely indispensable, while for the growth of the latter it is not requisite. Fungi appear to be an exception to this rule, as light is positively inimical to their growth, and they are known to thrive best when nearly or quite excluded from its influence. It is generally recognised, however, that these vegetable forms contain much nitrogen, and in this respect resemble animals.

It is also worthy of remark that although those portions of plants which possess least nitrogen need sunlight, those which have most nitrogen, viz., the seeds, develop and will germinate in the dark. Thus while the ferments previously alluded to are all nitrogenous, their very activity seeming to be due to nitrogen, those parts of living animals which possess the greatest vital activity contain also, comparatively speaking, the largest amount of this element. The metamorphosis of a substance, such as sugar, in the body and out of the body may be contrasted; it will then be proved that while in the living organism sugar is rapidly changed into carbonic acid and water, out of the body it has to go through several chemical conversions admitting of experimental demonstration, before these results are attained, it being first changed by fermentation into alcohol and carbonic acid, then into acetic acid, and lastly by further oxidation into carbonic acid and water. As, therefore, these changes in the body are clearly not produced by chemical and thermal actions solely, it may be inferred that they are brought about by means of that indirect influence known as catalysis.

Remedy for Damp.—When a solution of bichromate of potash (the crystals dissolve readily in hot water) is applied to any surface exposed to sunlight, and allowed to dry, it forms a coating which is very impervious to moisture. As the application of two coats of the solution (mixed with size to make it adhere) the walls of damp rooms, cellars, &c., may be made quite dry. The action of light produces a chemical change in the bichromate, which gives it this valuable property. Bills that have been posted on walls, &c., by means of size containing a little bichromate of potash (¼lb. to each gallon of size), adhere so firmly that it is impossible to remove them by any process short of scraping away the surface of the wall.

NOTE ON *LINGULA LESUEURI*, ROUAULT.

BY THOS. DAVIDSON, LL.D., F.R.S.

I have already fully described and illustrated this very remarkable species, and revert to the subject once more in order to allude to the able researches by W. J. Harrison, F.G.S., and to his excellent and instructive memoir "On the Quartzite Pebbles contained in the Drift and in the Triassic Strata of England; and on their derivation from an ancient land-barrier in Central England." *Lingula Lesueuri* has again been collected in some abundance by Mr. Harrison in quartzite pebbles from the Drift at Moseley, near Birmingham. The specimens or casts are sometimes found in a fine state of preservation, but, as far as I have seen, are much smaller in size than those that occur in similar pebbles at Budleigh-Salterton. It is the only species of Brachiopod from the lower portion of the Llandeilo or "Grès Armoricain" that has been hitherto obtained from the Drift of the Midland Counties, and it is somewhat remarkable that no example of *Lingula Hawkei*, *Lingula ? Salteri*, or *Dinobolus Brimonti*, which occur so plentifully with *L. Lesueuri* in the Budleigh-Salterton and Brittany localities, should have hitherto turned up in the Moseley or other Birmingham Drift localities. Along with the *Lingula Lesueuri* pebbles at Moseley and elsewhere Mr. Harrison has found sandstone and quartzite pebbles of the age of the Caradoc or "Grès de May" with *Orthis Budleighensis* in great abundance, and in company with *Orthis Valpyana*, *O. elegantula*, ? *O. unguis*, *O. calligramma*, and *Leptæna sericea*. A few fragments also of Middle-Llandovery rock with *Stricklandinia lirata* have been collected; also Lower-Devonian pebbles with *Spirifer Verneuili*, *Rh. Daleidensis*, *R. Valpyana*, *R. elliptica*, *R. Thebaulti*, *Orthis ? laticosta ?*, *O. Monnieri*, *Strophomena Edgelliana*, *Stroph. crenistria*, and one or two other species which owing to their bad state of preservation I was unable to determine.

No rock *in situ* has, however, been hitherto discovered in Great Britain containing *Lingula Lesueuri*.

Mr. Harrison remarks that "it seems perfectly clear that the quartzite pebbles which occur so abundantly in the Drift of the Midland Counties were derived from the pebble-bed or conglomerate which forms the middle member of the Bunter Sandstone or Lower Trias."

I have carefully examined and described the Brachiopoda from the Grès Armoricain (*Lower Silurian*) of Brittany. It

* From the Volume issued by the Palæontographical Society for 1883.

contains four species, viz., *Lingula Lesueuri*, *L. Hawkei*, *L.? Salteri*, and *Dinobolus Brimonti*. In the "Grès Armoricain" of Bagnoles, Département de l'Orne, I found *Lingula Lesueuri*, *L. Hawkei*, *L. Salteri* (very large and abundant), and *Dinobolus Brimonti* (rare). In the same rock and formation in the Département de la Sarthe are *Lingula Lesueuri* (small), *L. crumena* (abundant), and *L. Criei*, Dav. (very abundant); but in the Département de la Sarthe Mr. Guillier found no examples of *Lingula Haukei* nor of *Dinobolus Brimonti*. At Budleigh-Salterton we have *Lingula Lesueuri*, *L. Hawkei*, *L. crumena*, *L. Salteri*, and *Dinobolus Brimonti;* so that the only species not found in our British quartzite pebbles is the *Lingula Criei*.

In a very instructive paper by the Rev. P. B. Brodie "On certain Quartzite and Sandstone Fossiliferous Pebbles in the Drift of Warwickshire," published in the "Quarterly Journal of the Geological Society" for August, 1881, will also be found many points of much interest relating to the possible source of derivation of the quartzite pebbles of the Midland Counties.

COHN'S CALCULATION OF THE MULTIPLICATION OF BACTERIA.—Let us suppose that a bacterium divides into two in the space of an hour, then into four at the end of a second hour, then into eight at the end of three hours; in twenty-four hours the number will already amount to more than sixteen millions and a half (16,777,220); at the end of two days this single bacterium will have multiplied to the incredible number of 281,500,000,000; at the end of three days it will have reached forty-seven trillions, and at the end of about a week, a number which can only be represented by fifty-one figures. In order to render these numbers more comprehensible, let us consider the volume which may result from the multiplication of a single bacterium. The individuals of the most common species of rod-bacteria present the form of a short cylinder having a diameter of a thousandth of a millimetre, and about one five-hundredth of a millimetre in length (that is, about 1-12,500 of an inch long by 1-25,000 of an inch broad). Let us figure to ourselves a cubic millimetre. This volume would contain, according to what we have just said, 633,000,000 bacteria, without leaving any empty space. Now, at the end of twenty-four hours, the bacteria coming from a single rod would occupy the fortieth part of a cubic millimetre; but at the end of the following day they would fill a space equal to 442,570 of these cubes, or about half a litre. Let us admit that the space occupied by the sea is equal to two-thirds of the terrestrial surface, and that its mean depth is a mile, the capacity of the ocean will then be 928,000,000 cubic miles. Now, the bacteria issuing from a single germ, the multiplication being continued on the same conditions, would fill the whole ocean in five days.—A. MAGNIN, on the Bacteria.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

Continued from page 48.

BORAGINACEÆ.

ECHIUM.

E. vulgare, *Linn. Common Viper's Bugloss.*
Native: In sandy fields, old walls, and copses. Very local. July to September.

I. Oscott College grounds, *Rev. J. C.;* field on outskirts of Sutton Park, near the town, *W. B. Grove;* Westwood Coppice, Sutton Park; sandy lane, Wylde Green; sandy field, Marston Green; fields near Gibbett's Hill, Coleshill; Coleshill Heath.

II. Near Stratford, on the Bidford Road; stone quarries, Coten End and Woodloes, *Perry Fl.;* on a wall at Salford; about the lime-kilns at Grafton, *Purt.* i., 110; Trent Valley Railway, near Rugby, 1867; Cawston, Hill Morton, *R. S. R.*, 1871; Kenilworth ruins, *Rev. A. Blox.;* Lighthorne, *Bolton King;* Binton.

PULMONARIA.

P. officinalis, Linn. Common Lungwort.
Alien: In shrubberies. Very rare. July.

I. In a shrubbery near Elmdon Hall, probably an escape from cultivation.

II. Arbury Hall, *T. Kirk. Herb. Perry.*
I do not think this plant has any claim to be considered as more than a casual in this county.

[*Echinospermum Lappula,* Linn. As a casual, near the skin-yards, Kenilworth, *H. B.!*]

LITHOSPERMUM.

L. officinale, *Linn. Common Gromwell.*
Native: In woods, copses, and hedge-banks. Rather rare. June, July.

II. Great Alne! Oversley Wood! *Purt.* i., 112; footpath leading from Alcester to Wixford, *Perry Fl.* 15; Whitnash, Myton, *Y.* and *B.;* Itchington Holt; Ufton, *Cross. Herb. Per.;* Lodge Woods, Salford Priors! *Rev. J. C.;* Gaydon! *Bolton King;* Drayton Bushes; near Rose Hall, Oversley; near Binton and Red Hill; near Chesterton Wood; near Southam.

L. arvense, *Linn. Corn Gromwell. Painting-root.*
Colonist: In corn and other cultivated fields. Local. May, June.

I. Siden Hill, Hampton-in-Arden, *R. Rogers;* cornfields near Knowle; cornfields, Solihull.

II. Whitnash, *Y.* and *B.;* Tredington, *Newb.;* near Dunchurch and Little Lawford, *R. S. R.*, 1877; cornfield near Prince Thorpe; Bascote Heath; Billesley; Binton; fields between Meriden and Coventry.

MYOSOTIS.

M. cæspitosa, *Schultz.* *Tufted Water Forget-me-not.*
Native: Near streams, pools, ditches, and marshy places. Rather common. June to September.

I. Sutton Park; Middleton Heath; canal near Atherstone; near Kingsbury; Coleshill Pool; Marston Green; Hampton-in-Arden; Solihull; Olton Pool; near Berkswell, &c.

II. Watery places on Stoke Heath! Whitley Common! Coventry Park, Arbury! *Kirk. Phyt.*, i., 971; near Brown's Over and Clifton Mills, *R.S.R.*, 1877; Honington, *Newb.*; canal near Stratford-on-Avon.

M. palustris, *With.* *Great Water Forget-me-not.*
Native: Near streams, pools, ditches, and marshy places. Local. May to July.

I. Sutton Park; Middleton Heath; near Kingsbury; Canal near Atherstone; Water Orton; Coleshill Pool; Meriden Marsh; Solihull.

II. Honington! *Newb.;* Cathiron Lane, near Rugby; Combe Pastures; Sowe Waste; Ansty, near Coventry; Drayton, near Stratford-on-Avon.

Var. *strigulosa*, rare.
Blythe Bridge, near Solihull; canal near Bearley.

M. repens, *Don.* *Creeping Water Forget-me-not.*
Native: By pools and streams and marshes. Rare. June to August.

I. Bog near Stonebridge! *W. C. Herb. Perry.* Sutton Park, abundant; Trickley Coppice; drains between Forge Mills and Coleshill; Hill Bickenhill; Olton Pool.

M. sylvatica, *Ehrh.* *Wood Scorpion-Grass.*
Native: In woods and copses. Rare. April to June.

I. Hartshill! *Herb. Perry;* in a ditch, near Arley, *W. B. Grove;* coppice near Shustoke; dingle near New Fillongley Hall; near Maxtoke Priory.

II. In plantations near Arbury Hall, *T. Kirk, Phyt.* ii., 971; by Chesterton Mill Pool! *H. B.;* abundant in a coppice near Henley-in-Arden.

M. arvensis, *Lehm.* *Field Forget-me-not.*
Native: On hedgebanks, waysides, in woods and arable land. Common. April to September. Area general.

b. umbrosa. Locally common.

I. Near Maxtoke; Fillongley; Kingsbury Wood; Solihull; Spring Coppice, Hockley.

II. Warwick Deer Park! *Dr. Baker;* Drayton Bushes; Studley Woods; Oversley Wood; Ragley Park.

M. collina, *Hoffm.* *Dwarf Forget-me-not.*
Native: On old walls and dry heathy places. Rare. May, June.

I. Sutton Park; Maxtoke Priory ruins; Coleshill Heath; Abbey walls, Nuneaton; Bradnock's Marsh, on foot-bridge, 1881.

II. Railway cutting near Stratford-on-Avon; Spernal Ash, *W. C. Herb. Perry;* Hare's Lane, Stratford-on-Avon, *Herb. Perry;* Kenilworth Castle, *T. Kirk, Herb. Perry;* Salford Priors! *Rev. J. C.;* Milverton, *Y.* and *B.;* peafield, Binley Common; near Brandon.

M. versicolor, *Reich.* *Yellow and Blue Forget-me-not.*
Native: In woods, heathy waysides, and fields. Local. April, June,
I. Sutton Park; Hill Wood, near Sutton; New Park, Middleton; Coleshill Heath; woods near Maxtoke.
II. Milverton, *Y.* and *B.* Near Lawford Heath, *R.S.R.*, 1877. Combe Woods; Oversley Wood; woods near Berkswell.

ANCHUSA.

A. arvensis, *Bieb.* *Small Bugloss.*
Native or Colonist: In cultivated fields, on banks and waysides. Rather local. June, July.
I. Railway banks, Sutton Park; fields, Witton; sandy fields near Coleshill and Great Packington; cornfields near Meriden Marsh; Marston Green; cornfields near Solihull and Knowle.
II. Salford Priors, *Rev. J. C.* Cornfields, Offchurch; near Brandon; hedge banks and cornfields, Binley, near Coventry; bridle road from Billesley to Wilmcote.

A. sempervirens, *Linn.* *Evergreen Alkanet.*
Denizen: On banks near villages. Rare. May to July.
I. In lanes about Edgbaston, plentiful! *With. Ed.* 7, ii., 281. Four Oaks, near Sutton.
II. Near Kenilworth in the Coventry Road! *Herb. Perry.* Crackley, *Y.* and *B.* Near Newbold Grange (escaped), *R. S. R.*, 1868. On the Fosseway near Brandon.

BORAGO.

[*B. officinalis*, Linn. *Common Borage.*
Casual; On waste heaps and in fields. Very rare. June to August.
I. As a weed in cultivated ground, Hampton-in-Arden, *Rogers;* on a rubbish heap, Birmingham Road, near Solihull, 1876.
II. Among some rubbish in a field by the Arrow turnpike, *Purt.* i., 111; in gardens at Warwick and Leamington, *Perry Fl.*, 16.
Merely a remains or escape from cultivation.]

SYMPHYTUM.

S. officinale, *Linn.* *Common Comfrey.*
Denizen: By river banks, near streams, etc. Rare. May to August.
I. By the River Tame, Witton and Aston; near Knowle; Solihull; Olton; Sutton; near Oscott College; waysides near Temple Balsall.
II. River Arrow, near Oversley Bridge! *Purt.* i., 108; near Stoneleigh Mill; roadside between Tredington and Shipston! plentiful, *Perry Fl.*, 16. Kenilworth, Milverton, *Y.* and *B.* Near Brown's Over Mill. *R. S. R.*, 1877. Honington! *Newb.* Newbold Pacey.
Var. *patens*, Sibth. Honington! Tredington, Halford, *Newb.*

[*S. tauricum*, Willd. *Blistered Comfrey.*
Alien or casual: On banks. Very rare. May to August.
II. "Permanently established at Allesley! *Kirk*," *Comp. Cyb. Brit.*, 548. Occurs as a garden escape at Allesley, *Syme*, *E. B.* vii. 121. Established in enclosed ground between Leamington and Warwick, *Exch. Club. Rep.*, 1879, 24.]

[*S. tuberosum*, *Linn.* *Tuberous-rooted Comfrey.* Allesley, *T. Kirk*, *Herb. Perry.*]

CYNOGLOSSUM.

C. officinale, *Linn.* *Common Hound's-tongue.*
Native: On waysides and banks. Rare. June to August.
I. On a bank at Castle Bromwich, *Ick. Anal.*, 1837.
II. Hatton Rock, near Hampton Lucy; Fullbrook, *Y.* and *B.*; near Hampton Lucy, *Herb. Perry.* Compton Verney, Kenilworth, *H. B.* Halford, *Rev. J. Gorle.* Tredington! Honington! *Newb.* Lanes near Stratford! *Newb.* Between Stratford-on-Avon and Binton; bridle road from Billesley to Wilmcote; near Alveston Pastures.

C. montanum, *Lam.* (C. sylvaticum, *Perry*,) *Green-leaved Hound's-tongue.*
Native: On banks. Very rare. June to August.
II. "Pigwell Lane, Warwick, 1812. On a hedge bank, Cape of Good Hope, Warwick." *Perry Fl.*, 15. Dunspit Lane, Kenilworth; on a bank near the Copse, Warwick, *Herb. Perry.* Near Kenilworth Chase Wood, Milverton! *H. B.*

PINGUICULACEÆ.

PINGUICULA.

P. vulgaris, *Linn.* *Common Butterwort.*
Native: In bogs and marshes. Very rare. May to July.
I. Bannersley Pool! *Bree. Purt.* i., 55; Sutton Common! (with hybernacula), *Luxford Phyt.* i. 15; abundant here in 1881; bog near Chelmsley Wood, *Bree. Mag. Nat. Hist.* iii., 163; Coleshill bog.
II. Stivichall, near Coventry, *T. Kirk*, *Herb. Perry.*.

UTRICULARIA.

U. vulgaris, *Linn.* *Common Bladder-wort.*
Native: In pools and canals. Very rare. July.
II. Stoke Heath Canal, 1849, *T.K.*, *Herb. Perry;* pool on Commyn's Farm, near Stratford-on-Avon, *Cheshire;* pit at Balsall, *Bree. Herb. Perry;* canal at Longford, *Kirk;* old canals, near Rugby, *Blox. M.S.*

U. minor, *Linn.* *Lesser Bladder-wort.*
Native: In pools. Very rare.
I. In Powell's and Bracebridge Pools, and in small marshy pool, Sutton Park, 1877-9; not seen in flower.

PRIMULACEÆ.

HOTTONIA.

H. palustre, *Linn.* *Water Violet.*
Native: In pools and ditches. Very rare. June.
I. Between Coleshill and Tamworth, *Bree. Mag. Nat. Hist.*, iii., 163.

PRIMULA.

P. vulgaris, *Huds.* *Common Primrose.*
Native: On banks and in woods and copses. Locally common. March to May.
I. Sutton Park; Middleton; Sheldon; Solihull, &c.
II. Haywoods, Kenilworth; Allesley; Oversley, &c.
Var. flore-alba and var. flore-rubra, Allesley, *Bree. Purt.* iii., 341.
Var. *b. caulescens.* Rare.
I. New Park, Middleton.
II. Badger's Wood, Stratford-on-Avon, *Cheshire, Herb. Perry;* Balsall, *Herb. Perry.;* Lodge Wood, Salford Priors, *Rev. J. C.;* Haywoods; Wroxall.
Var. *c. intermedia.* Rare.

I. Hampton-in-Arden, *R. Rogers;* Wishaw; New Park, Middleton.
II. (P. variabilis) Oversley Wood! Lower Norton, *W.C.;* Wroxall, *Herb. Perry;* Honington, *Newb.;* Chadshunt, *Bolton King;* Rowington; near Yarningale Farm.

P. officinalis, *Linn.* *Cowslip.*
Native: In pastures and woods. Locally common. April, May.
I. Middleton; Hartshill; Solihull; Shustoke; Kingsbury, &c.
II. Tredington, Honington! *Newb.;* Alveston pastures; Oversley; Ragley; Rowington, &c.
A large form, with flowers nearly as large as those of the caulescent form of P. vulgaris occurs in Ragley Woods. Although *P. officinalis* cannot be considered more than a common plant in the county as a whole, it is very rare in some of the districts.

LYSIMACHIA.

L. vulgaris, *Linn.* *Common Loosestrife.*
Native: On river banks and damp shady places. Rare. July.
I. Coleshill on the Blythe, *Bree. Purt.* iii., 343. Marston Green.
II. Below Bidford Grange, *Purt.* i., 122; lane near Fern Hill Wood! *H.B.;* Radford, *Y. and B.;* Salford Priors, *Rev. J. C.;* Whatcote, *Rev. J. Gorle.*

L. Nummularia, *Linn.* *Creeping Jenny.*
Native: In woods. Wet meadows and ditches. Locally common. June to August.
I. Trickley Coppice; Hartshill Hayes; Bradnock's Marsh; near Packwood Church; lanes about Hockley; Earlswood.
II. Newwbold Pacey, *Rev. J. Gorle;* Lighthorne, *Bolton King;* Honington Park! *Newb.;* Salford Priors! *Rev. J. C.;* Brown's Over, *R.S.R.;* Oversley Wood; Alveston Pastures; Itchington Holt Lowson Ford; Haywoods; Combe Woods.

L. nemorum, *Linn.* *Yellow Pimpernel.*
Native: In damp woods and copses. Local. May to August.
I. Sutton Park; Trickley Coppice; New Park; Kingsbury Wood Bentley Park; Hartshill Hayes; Coleshill Pool; Marston Green; Hampton-in-Arden; Solihull; Hockley.
II. Prince Thorpe Wood; *R.S.R.*, 1877; Combe Woods; Seas Wood, Arbury; Haywoods; Chalcot Wood; Bush Wood, Lapworth; Oversley Wood.

ANAGALIS.

A. arvensis, *Linn.* *Scarlet Pimpernel.*
Native or colonist: In cultivated land, by roadsides, and on heathy waste places. Common. May to September. Area general.
Var. *b. pallida.* Scarbank, *W.C.*, *Herb. Perry!* Kenilworth, *Y. and B.*

A. cærulea, *Sm.* *Blue Pimpernel.*
Native or colonist: In gardens, fields, and by waysides in calcareous soils. Rather rare. June to August.
I. As a weed in a garden, Witton.
II. Bidford! Grafton! *Purt.* i., 115; Leamington, *Phyt.* i., 92; Whitnash, *H.B.*, *Herb. Brit. Mus.;* Binton! Billesley! Grafton! Saltisford, *Herb. Perry;* Moreton Morrell, Whitnash! *Y. and B.;* about Honington, *F. Townsend;* Chesterton, Kineton, *Bolton King;* Red Hill; Exhall; Loxley; Brandon.

A. tenella, *Linn.* *Bog Pimpernel.*
Native: In bogs, near streams and pools. Rare. June to August.
I. Bogs, Sutton Park! and Coleshill Bog! *Bree. Mag. Nat. Hist.* iii., 163; Olton Reservoir; shores of Coleshill Pool.
II. Kenilworth, *Y. and B.*

CENTUNCULUS.

C. minimus, *Linn.* *Bastard Pimpernel.*
Native: In damp, sandy drives in woods. Very rare. July, August.
I. In Bull's fields, and near Moor Hall, Sutton, *J. Power, B.G.*
II. Damp, sandy drive in Oversley Wood! *J. T. Slatter and J.E.B.;* sandy waysides, Balsall Heath, *H.B.;* damp, sandy drives, Combe Wood, 1880.

SAMOLUS.

S. Valerandi, *Linn.* *Brook-weed.*
Native: Near rivers, and in damp, marshy meadows. Rare. July to September.
II. River Alne above Oversley; in some boggy ground near Bidford Grange, *Purt.* i., 120; near the River Leam, Leamington, *Perry Fl.;* Itchington! *Bree. Mag. Nat. Hist.* iii., 163; Luddington; Itchington Holt! Straford-on-Avon, *W.C.*; near Leamington, *W.G.P.*, *Herb. Perry;* Salford Brook, *Rev. J.C.;* near Halford, *Newb.;* Kineton, *Bolton King;* wet meadows west of Blackwell, *F. Townsend;* Birdingbury, *Y. and B.*

(*To be continued.*)

CARDIFF NATURALISTS' SOCIETY.*

I had intended giving (according to the custom of inaugural addresses) some account of the progress of scientific discovery during the last sixteen years, but the range is so wide, and its history has already been told so well and so often elsewhere, that I do not feel justified in doing more than glancing at a few of its more salient points. The development of scientific knowledge, which during the 19th century has been unexampled in the history of mankind, has been especially marked during the period of our existence as a society. The most important of the more recent developments are Spencer's and Darwin's theories of evolution. Mr. Darwin's great work, "The Origin of Species," was published ten years before the birth of our Society, but at the time this commenced its career it was still comparatively unknown. No single person in Cardiff, so far as I know, believed in it, or, at any rate, no one dared avow a belief in it. I shall never forget the intense interest with which I read that wonderful book. The marvellous theory seemed to influence every event and circumstance, however trivial or however important, and invested every department of human enquiry with a new and absorbing interest. That such wide-reaching consequences could follow from a principle so simple is astonishing. What can be more simple or obvious than the fact that the production of organic beings is vastly in excess of their means of support? We know, for instance, that corn is so productive that a bushel of it re-sown would, if unchecked, cover the whole surface of the earth in nine or ten years. We learn that the common watercress, introduced by English emigrants, already

* Extract from INAUGURAL ADDRESS read before the Society, 24th January, 1884, by PETER PRICE, President and Treasurer.

fills almost to choking the rivers of New Zealand, and so on. Mr. Darwin's book contains the most interesting instances of this prolific and excessive reproduction. This fact, viz., excessive reproduction, is one of the bases of Darwin's theory. The other is equally simple, certain, and obvious, viz., that all organic beings differ more or less from their progenitors. For instance, out of millions of human beings, there is seldom one so like another that they cannot be distinguished. Now a necessary consequence of these two undoubted facts, viz., the excessive reproduction of individuals and their continuous variation, must cause a struggle for life, ending in an extinction of the weakest—thus leading to a constant modification of all organic beings from one generation to another. These positions are so demonstrably true, that one is now inclined to wonder how they could ever have been doubted. It is, however, a significant and instructive fact, that not only were these conclusions reached with difficulty, and reluctantly accepted, but they are still received with doubt and misgiving by those who have not considered the subject. It affords another instance to be added to the many which history furnishes of the unwillingness or inability of the human mind to accept a new view or a new idea which strays from "the even roadway of public opinion." Soon after the establishment of this society I prepared a paper on Darwinism, but, at the earnest request of some of the members, I withdrew it, as it was feared that the advocacy of such a daring inroad upon current beliefs would imperil the existence of our young society. Since then we have had the satisfaction of hearing Darwinism acknowledged and advocated by one of our most eminent lecturers—himself a minister of the Gospel, and even from a local pulpit. What a remarkable change in 16 years! There are many indications which go to show that this theory, like so many others, received at first with mingled derision and alarm, will eventually become one of the commonplaces of ordinary belief. Darwinism is, however, only one phase of the still wider theory of evolution. It is, in fact, the theory of evolution applied to Biology, just as Malthusianism is Darwinism applied to human beings. The theory of evolution, as propounded by Herbert Spencer, is a still more wonderful product of the human intellect than Darwinism; but it is perhaps more difficult to grasp, and, therefore, less widely appreciated. I am inclined to think that in the next age Spencer's name will stand higher even than that of Darwin. We know that Spencer preceded Darwin in the enunciation of the all-embracing principle of evolution, and that he has worked it out with a wider grasp of its necessary consequences. "The First Principles" of Spencer, and "The Origin of Species" of Darwin, will hereafter rank in the annals of science with Bacon's "Instauratio Magna" and Newton's "Principia." It is interesting to note the different ways in which this theory of evolution is presented in these two books. Broadly, it may be said that Darwin proves his principle by inductive reasoning, and Spencer by deductive reasoning. Darwin laboriously and patiently accumulates instances, the result of a life of continuous and accurate observation, from which he cautiously draws the inevitable conclusion that all organic beings have been derived and developed from a primordial germ. To this conclusion he strictly limits himself, looking neither before nor after. Within that limit he proves his case to demonstration, but there is no trace in his book which shows that he appreciated the immensely wider consequences that must necessarily flow from the principle which he establishes. In Spencer, on the other hand, the reasoning takes an opposite course. He deduces his theory from fundamental principles, viz., from the indestructibility of matter, the conservation of force, the transformation and equivalence of the physical forces, and the continuity of motion. From these principles he argues *deductively* that evolution is a necessary condition of things, and that everything is a "flux" or a "becoming," to use the language of the Greek Philosopher. Having thus established his principle he traces the effects which must necessarily follow, not only in biological phenomena, but into every department of science and philosophy. Darwin confines his attention to the effect produced on the life and development of plants and animals only. Spencer, on the other hand, shows its application to the entire *Cosmos*. He weaves in the nebular hypothesis and the geological history of the earth. To it he traces the development of life upon its surface, the constitution of the human mind, the development of the principles of government, political economy and commerce, the development of language, science, and æsthetics, and in it he finds a new basis for the principles of morals. In all these departments of knowledge Spencer has applied his theory with profound insight and the most marvellous skill, and the series of works which he is publishing in its elucidation strikes me as one of the most profound productions of modern philosophy. His theory will eventually become a new point of departure in every department of human enquiry.

HIGH LAND AND GREAT MOISTURE ESSENTIAL TO THE INITIATION OF A GLACIAL EPOCH.

A point of great importance in connection with the occurrence of a Glacial Epoch is the fact that the permanent storing up of cold depends entirely on the annual amount of snow-fall in proportion to that of the sun and air heat, and not on the actual cold of winter or even on the average cold of the year. A place may be intensely cold in winter and may have a short Arctic summer, yet, if so little snow falls that it is quickly melted by the returning sun, there is nothing to prevent the summer being hot and the earth producing a luxuriant vegetation. As an example of this we have great forests in the extreme north of Asia and America, where the winters are colder and the summers shorter than in Greenland in lat. 62° N., or than in Heard Island and South Georgia, both in lat. 53° S., in the Southern Ocean, and almost wholly covered with perpetual snow and ice. At the "Jardin" on the Mont Blanc range, above the line of perpetual snow, a thermometer in an exposed situation marked $-6°$ F. as the lowest winter temperature, while in many parts of Siberia mercury freezes for several weeks in winter, showing a temperature below $-40°$ F.; yet here the summers are hot, all the snow disappears, and there is a luxuriant vegetation. Even in the very highest latitudes reached by our last Arctic Expedition there is very little perpetual snow or ice, for Captain Nares tells us that north of Hayes' Sound, in lat. 79° N., the mountains were remarkably free from ice-cap, while extensive tracts of land were free from snow during summer, and covered with a rich vegetation with abundance of bright flowers. The reason of this is evidently the scanty snowfall, which rendered it sometimes difficult to obtain enough to form shelter-banks around the ships, and this was north of 80° N. lat., where the sun was absent for 142 days.

It is a very remarkable and most suggestive fact that nowhere in the world at the present time are there any extensive lowlands covered with perpetual snow. The Tundras of Siberia and the barren grounds of North America are all clothed with some kind of summer vegetation; and it is only where there are lofty mountains or plateaus—as in Greenland, Spitzbergen, and Grinnell's Land—that glaciers, accompanied by perpetual snow, cover the country, and descend in places to the level of the sea.

The reason why no accumulation of snow or ice ever takes place on Arctic lowlands is explained by the observations of Lieutenant Payer, of the Austrian Polar Expedition, who found that during the short Arctic summer of the highest latitudes, the icefields diminished four feet in thickness under the influence of the sun and wind. To replace this would require a precipitation of snow equivalent to about forty-five inches of rain, an amount which rarely occurs in lowlands out of the Tropics. In Siberia, within and near the Arctic circle, about six feet of snow covers the country all the winter and spring, and is not sensibly diminished by the powerful sun so long as northerly winds keep the air below the freezing-point and occasional snow-storms occur. But early in June the wind usually changes to southerly, probably the south-western anti-trades overcoming the northern inflow; and under its influence the snow all disappears in a few days and the vegetable kingdom bursts into full luxuriance. This is very important as showing the impotence of mere sun-heat to get rid of a thick mass of snow so long as the air remains cold, while currents of warm air are in the highest degree effective. If, however, they are not of sufficiently high temperature, or do not last long enough to melt the snow, they are likely to increase it from the quantity of moisture they bring with them, which will be condensed into snow by coming into contact with the frozen surface. We may therefore expect the transition from perpetual snow to a luxuriant Arctic vegetation to be very abrupt, depending as it must on a few degrees more or less in the summer temperature of the air, and this is quite in accordance with the fact of corn ripening by the sides of Alpine glaciers.—*A. R. Wallace*, from "Island Life."

DEEP BORING AT SAPCOTE, LEICESTERSHIRE.

In a paper in your last number on the "Syenites of South Leicestershire," Mr. W. J. Harrison, F.G.S., refers to a boring made some years ago, about two miles east of Hinckley, at Sapcote Freeholt, by Mr. J. A. Bosworth, F.G.S. Mr. Harrison states that after passing through 540 feet of red marls, the boring was carried down through 1,100 feet of hard slates. In the next sentence, without any explanation, he decides that these slates were Cambrian. If he had made the least enquiry he could scarcely have failed to learn that this was one of the few borings carried out under the supervision of a competent geologist. The cores were all examined by Mr. Robert Etheridge, F.R.S. He discovered in them Flemingites (Carruthers), and so settled that the so-called slates belonged to the Coal Measures.—John D. Paul, Leicester, 21st February, 1884.

[Perhaps Mr. Paul will kindly refer me to any statement by Mr. Etheridge that the lower beds reached at Sapcote were true coal measures. I am well aware that somebody else said that Mr. Etheridge said so twenty years ago, but that is not evidence. I need not say that I have made every possible enquiry as to the age of the Palæozoic rocks reached in the various borings made of late years in the centre, south, and east of England; I have visited the places, examined the cores, and consulted all available sources of information. In my paper on the "Quartzite Pebbles of the Trias, and on their Derivation from Ancient Land in Central England," I have used a portion of the information so obtained; in the paper on the "Syenites of South Leicestershire," to which Mr. Paul refers, I only mention the Sapcote boring incidentally, and do not, therefore, go into details. The fact is that the key to the true age of the coarse much-jointed slates reached in the several borings put down at Sapcote, Leicester, Market Bosworth, etc., lies in the discovery, made by Professor Lapworth and myself early in 1882, of the Cambrian age of the rocks exposed in the Stockingford cutting, near Nuneaton. Until that time these Stockingford rocks were also supposed to be Lower Coal Measures, and were so mapped by the Geological Survey. Now these very rocks at Stockingford have been referred to by Mr. Bosworth (by whom the Sapcote boring was executed) as being similar to the strata reached at Sapcote. The Sapcote boring was made nearly twenty years ago; it is possible that Mr. Etheridge may at that time have been of opinion that the lower beds there reached were of Coal Measure age, though he has published nothing on the subject. It is also just possible that the boring there may have passed through a stratum of coal measures lying between the Red Marls and the Cambrians. Still, I think it more probable that the whole of the lower beds pierced at Sapcote were of Cambrian age. Has Mr. Paul any authority from Mr. Etheridge to state what his opinions were, and are, as to the age of the rocks alluded to? If so, I shall be glad to discuss the question with the latter gentleman.—W. J. Harrison.]

Reviews.

Energy in Nature. By W. Lant Carpenter. 8vo., 212 pp., 81 woodcuts. Price 3s. 6d. Cassell & Co.

Mr. Lant Carpenter has done good service to the cause of science in many ways, among which his lectures delivered in connection with the Gilchrist Trust may be specially named. The admirably clear and interesting book which he has now written had its origin in a course of six lectures lately delivered to the artisans of certain Lancashire towns, and it probably owes much of the simplicity combined with thoroughness, which is its leading feature, to the circumstances under which it was written.

Commencing with Mechanical Energy, Mr. Carpenter passes on to Heat, Chemical Attraction, Electricity, and Magnetism, and shows by clear reasoning and well-selected experiments how all these forms of energy are connected and convertible—any one into any other. The last chapter, which deals with Energy in Organic Nature, will be especially interesting to students of Natural History. Throughout the work the very latest results of scientific investigation are used and described.

W. J. H.

The Geology of Stroud. By E. Witchell, F.G.S. 8vo., 108 pp., 5 plates. Price 3s. 6d. G. H. James, Stroud.

Too many of our local workers in science leave no record of the facts which they have ascertained; we therefore welcome the publication, in a compact and connected form, of the results obtained by so careful and thorough a geologist as Mr. Witchell. Stroud forms an admirable centre for the study of the Oolitic and Liassic strata, including the debatable sandy beds—which the author proposes to term the *Cotteswold Sands*—that lie between the clays of the Lias and the limestones of the Oolite. The physical geography of the district is described in the first chapter, and in those which follow the various formations are considered in detail, commencing with the *Lower Lias* and ending with the *Cornbrash.* The last chapter deals with the Gravels, River Deposits, and Surface Denudation of the district under consideration. The principal sections of the country round Stroud are fully described, and very complete lists of the fossils obtained are given. The illustrations include two plates of sections and three plates of fossils.

W. J. H.

Natural History Notes.

Mr. Herbert Spencer.—It will interest the admirers of Mr. Herbert Spencer to hear that his works, which have already been translated into the principal Continental languages, have recently been translated into Japanese, and are now being reprinted in Australia.

CROFT HILL.—I think the height of Croft Hill, as stated on page 9, vol. vii., of the "Midland Naturalist," is in excess. I have measured height by the barometer many times, and the mean of my measures is 456 feet. Bench mark at Narborough Church, 241ft.; rails at Narborough Station, 220; rails at Croft Station, 239; river at Croft, 231.—W. ANDREWS, Coventry.

WATERPROOF PAPER.—When paper is treated with ammoniacal sub-chloride of copper it is rendered water-proof and rot-proof; even boiling fails to separate the fibres. Such paper is now being manufactured by a company (Mr. Healey, manager) at Willesden. There are many purposes to which it can be usefully applied by students of natural history. The extreme width in which it is manufactured is a yard and a half.

MILDNESS OF THE SEASON.—The unusually fine weather which prevailed from the 1st to the 26th of January, 1884, when it terminated in a hurricane and a frost succeeded, enabled us to gather primroses and several spring flowers in the garden; but the most noteworthy instance was that of a fine scarlet rhododendron (Russelliana?) which continued flowering in the garden of Endwood Court all the month. On Sunday, 13th January, I counted twenty blossoms on this beautiful plant.—W. R. HUGHES, Handsworth, 20th January, 1884.

TEMPERATURE IN AUSTRALIA.—The heat and dryness around Adelaide have been so remarkable that a few scientific statistics will be of interest to my meteorological friends. The plains of South Australia are undoubtedly, for absolute values, the hottest and driest regions in the British Empire. At 3 P.M. on January 13th I registered the following figures at my observatory on the plains, bordering the river Torrens:—Shade temperature of air by dry bulb, 107·0; temperature of evaporation by wet bulb, 69·7—giving the extraordinary difference of 37·3 degrees between the dry and wet thermometers. The shade maximum for twelve hours ending 9 P.M. was 109·6, and the solar maximum (black bulb *in vacuo*) 152·3. The temperature of the ground at a depth of 1 foot at 9 P.M. was 91·0. Both man and beast suffered severely during this parched heat; yet really the climate at this season is not unhealthy to the adult, and I feel the heat less than when under a temperature of 83 in the Tropics. A greater change from the climate of Ben Nevis, where temperature averaged 36·0, and where the wet bulb rarely read a degree lower than the dry, can scarcely be imagined.—CLEMENT L. WRAGGE, Adelaide, South Australia, Jan. 19th, 1884.

TECHNICAL SCHOOL FOR BIRMINGHAM.—Encouraged by the success of the science teaching in the Birmingham Board Schools, Mr. George Dixon, the Chairman of the Board, has most generously offered extensive premises in the centre of the town, rent free, for the purpose of a technical school, defraying at the same time the cost of the necessary structural alterations, which will amount, we believe, to over £2,000. The School will possess an excellent chemical laboratory, provided with work-benches for forty students, a lecture theatre to seat eighty, a carpenter's shop and lathe-room for forty, a room for geometrical and model drawing, with large class rooms for mathematics and literature, and a dining-hall. The school will be maintained by the Birmingham School Board, and the scientific and technical training will be given under the direction of Mr. W. J. Harrison, Science Demonstrator for the Board. The Dixon Technical School is intended for boys who have passed through the six standards of the "Code" in one or other of the thirty Board Schools of the town, and whose parents are willing to give them one or two years' further instruction in practical science. The building will accommodate 240 boys, and within three days of the announcement of Mr. Dixon's offer, applications were received from 280 of the parents of boys now in the sixth or seventh standards of the Birmingham Board Schools, desiring that their sons might be admitted to the school, and undertaking to keep them there for at least one year. It is hoped that the school will be ready to open in June next.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, Jan. 29th.—Mr. J. E. Bagnall exhibited a series of mosses from Merivale and Baddesley, including *Hypnum tenellum* (rare); and a lichen, *Cladonia uncialis*, new to the county; also (for Mr. J. B. Stone) *Dicranum longifolium*, in fruit; *Pylaisæa polyantha*, and *Bartramia ithyphylla*, from Norway. Mr. R. W. Chase then read a paper, entitled "Notes on the Terns Breeding at the Farne Islands," which is printed in this number. —ANNUAL GENERAL MEETING, Feb. 5th.—The annual report and treasurer's audited accounts were read and adopted, and will be sent to the members. After the usual complimentary votes, the following officers and committee were elected for the ensuing year:—President, Mr. T. H. Waller; vice-presidents, Messrs. R. W. Chase and J. E. Bagnall; ex-presidents (who are vice-presidents), Messrs. W. Graham, W. R. Hughes, J. Levick, and W. Southall; treasurer, Mr. C. Pumphrey; librarian, Mr. W. B. Grove; curators, Messrs. R. M. Lloyd and H. J. Sayer; committee: Messrs. J. F. Goode, W. Hillhouse (Professor), C. Lapworth (Professor), W. P. Marshall, J. Rabone, and Edmund Tonks; secretaries, Mr. J. Morley and Mr. W. H. Wilkinson. The meeting was then adjourned. BIOLOGICAL SECTION, Feb. 12.—Mr. W. P. Marshall was elected Chairman, and Mr. J. F. Goode, Secretary. Mr. J. E. Bagnall exhibited mosses: *Fontinalis antipyretica*, new locality, Earlswood; *Fissedens inconstans*, new to North Warwick, Hockley; *Bryum obconicum*, new to county, Rowington; *Amblystegium riparium* var. *longifolium*, new to South Warwick; and other mosses. Fungi: *Trametes suaveolens*, new to the district, Hampton-in-Arden. For Mr. J. B. Stone, *Hyocomium flagellare*, from New Forest; *Dicranodontium longifolium*, *Cynodontium strumiferum*, *Bartramia Halleriana*, and other mosses from Norway. For Dr. M. C. Cooke, *Auricularia mesenterica*, *Phlebia merismoides*, *Merulius molluscus*, *Hydnum Weinmanni*, and other fungi; also *Hypnum Kneiffii* and *Sendtneri* from South Beds, collected by Mr. J. Saunders; *Rosa melvini*, a new variety of *Rosa sempervirens* from Malvern, collected by Mr. Towndrow. Mr. W. P. Marshall exhibited a new method of drawing objects for reproduction by lithography, which was very effective. Mr. Egbert de Hamel, President of the Midland Union of Natural History Societies, and Treasurer of the Tamworth Natural History and Antiquarian Society, read a paper on "Elementary Biology." He began by drawing a parallel between the elements and the alphabet. Just as from the letters of the alphabet syllables are formed, from the words sentences, and finally, an eloquent book which lives in the hearts of men long after the hand that wrote it has passed away; so from atoms are formed molecules, from molecules chemical compounds, from chemical compounds minerals and organic beings, of which the beautiful world of nature is composed. He then proceeded to trace out the numerous analogies which are now known to exist between the organic and the inorganic kingdoms—the resemblance of a snow-crystal to a fern, a flower, and even to a skeleton; the similarity in form of a starch granule and a crystal of carbonate of lime, crystallised under certain conditions; the formation of pseudo cells from truly inorganic matter; the gradual passage from the molecules of the simple crystalloids, with their few atoms, to the more complex colloids, and finally to the complicated molecules of albumen (containing 883 atoms) and bathybius (containing 1,120 atoms.) He showed, too, how pure crystalline substances, when crystallising in the presence of ammonia or free nitrogen, assume more tree-like forms than those which are proper to them under ordinary conditions. A series of beautiful slides illustrating this change was exhibited, and the paper was also illustrated by many diagrams and other means. Dr. Hill then made some remarks drawing especial attention to Dr. Beale's discovery of mildew (1870) and also to a fallacy (as he believed) in the reasoning concerning the crystallisation of chloride of ammonium and bichromate of potash, in the one case the result being the same whether ammonia is added or not, in the second, not, the latter being a double salt. A discussion then arose, in which Messrs. Hughes, Grove, Greatheed, and the Chairman, Mr. W. P. Marshall, took part.—GENERAL MEETING, Feb. 19.—A vote of condolence was passed to the family of the late Mr. R. M. Lloyd, a gentleman who was much respected for his quiet but efficient services in the care and manipulation of the microscopes of which he was in charge.—Mr. T. H. Waller, the President, showed, by means of the Society's new oxyhydrogen microscope, a number of thin sections of rocks, illustrating the order in which the various minerals composing them have separated, and the different forms which minerals, especially quartz, have assumed, under varying conditions of formation. Mr. J. Levick also exhibited the following living specimens of pond life, the moving cilia of some of which were beautifully shown by his careful dark background illumination: *Stylonichia mytilus*, *Brachionus urceolaris*, *Synchæta Mordax*, *Stephanoceros Eichhornii*, *Stentor polymorphus*, *S. Ræselii*, and *S. Mülleri*. Mr. R. T. Brain also exhibited a lichen, *Usnea barbata*, the fruit of which was well formed on the ciliated disks; this lichen is common, but is rarely met with in fruit. Also a fungus, *Polyporus versicolor*, from the south coast, and a piece of rock supposed to have come from Java. SOCIOLOGICAL SECTION, February 21st.—Mr. Hughes was re-elected President of the Section, and Mr. F. J. Cullis was elected Secretary. A few of the members assembled an hour before the ordinary meeting and made a commencement with the compilation of an index to Mr. Herbert Spencer's smaller work on Sociology. This enterprise has the approval of Mr. Spencer, and is being conducted on a plan arranged by Mr. F. H. Collins. The President read some very pleasant letters from some Sociologists at a distance who are interested in the section, and Mr. J. O. W. Barratt repeated (by special request) his illustration of the material changes occurring during the life of an Amœba. The study of Mr. Spencer's "Principles of Biology" was then proceeded with, Chapter 7 of Part II. being introduced by Mr. W. W. Collins, and this was followed by a discussion, in which the President, Messrs. C. H. Allison, W. Greatheed, S. D. Williams, and the Secretary took part.

BIRMINGHAM AND MIDLAND INSTITUTE SCIENTIFIC SOCIETY.—Feb. 6.—Mr. C. J. Watson gave an interesting description of a trip "Round Snowdon with a Camera," and exhibited a large number of slides, many of them showing the effects of the Glacial Period.—On Feb. 13 Mr. E. B. Marten, C.E., of Stourbridge, showed some beautiful apparatus made by Mr. Wm. Grove, after the designs of Mr. Stroh, of London, to illustrate the action of vibrating discs or drums upon one another, causing attraction when their movements or vibrations are alike and repulsion when they are unlike. Also, when a light metal disc was suspended between two vibrating drums it arranged itself in the line of their axes when the vibrations were alike, and at right angles to the axes when unlike. The same kind of disc was suspended between two electro magnets when it showed movements very analogous, but in reverse order, as it was at right angles to axes of the magnets when they were both similar poles and in the line of the axes when the poles were contrary. It was explained that this had been noted by Dr. C. A. Bjerkner, of Christiania, in 1856, and illustrated by beautiful apparatus for showing the effects upon bodies suspended in water at the Paris Electrical Exhibition. Similar effects were shown with a cardboard vane poised like a weather-cock, and also with two discs connected like a pair of spectacles and suspended by a thread. The action was explained by showing that when the discs approached the air between was driven out sideways, and on parting a partial vacuum was formed between them, and the air at the back of the disc on the vane pushed it forward. If a rim was put round the vibrated disc the action was the reverse, and the vane was repelled. Some other curious effects of atmospheric impact were illustrated with a disc suspended before a hole in a box with an elastic side, which approached when the beating of the side caused a puff of air and a reaction. The same was shown by a disc held up by a current of air from a hole in the centre of another disc; and again by the falling of some cardboard figures towards a vibrated disc. Two large diagrams made for that meeting explained the work of Dr. Bjerkner and Mr. Stroh respectively. Feb. 20th.—Mr. W. W. Staveley read a paper on "Fractional Distillation." After briefly alluding to the history of the subject, he dealt with the various forms of apparatus used in the laboratory, and the industrial apparatus used on an immense scale in the manufacture of alcohol, benzene, etc., showing, by means of diagrams, the gradual advance from the primitive cucurbit or alembic of the old alchemists to the complicated apparatus of the present day. He next gave comparative results obtained with each form of apparatus, and concluded by presenting in a succinct form all that is at present known relating to the theory of distillation.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—January 21st, opening night at new rooms.—Mr. Darley exhibited a collection of moths, including among many others large and small elephant hawk, wood tiger, scarlet tiger *C. innabar*, large emerald, etc., etc.; Mr. Madison, *Limnæa pereger* var. *albida* and *Ancylus fluviatilis* var. *albida* from Westmoreland; Mr. Delicate, a stuffed specimen of jack snipe (*Gallinago gallinula*). The following objects were shown under the microscopes:—Mr. Dunn, larva of day fly (*Ephemera marginata*); Mr. Darley, rotifers; Mr. Foster, *Cyclops quadricornis*; Mr. Tylar, *Daphnia pulex*; Mr. Moore, circulation of blood in a fish; Mr. C. P. Neville, *Hydra vulgaris*; Mr. Bradbury, *Sarcoptes scabiei* and *Pediculus vestimenti*; Mr. J. W. Neville, *Melicerta ringens*; Mr. Flower, head of crane fly (*Tipula oloracea*). January 28th.—Mr. Hawkes, a specimen of tooth-wort (*Lathræa squamaria*), from Halesowen; Mr. Darley, hybernated larvæ of fox moth; Mr. Dunn, great water mite (*Hydrachna geographica*); Mr. Tylar, trans. section of echinus spine; Mr. Moore, trans. section of *Lithostrotion basaltiforme*, a fossil coral from Plymouth; Mr. J. W. Neville, deep sea dredgings from Indian Ocean; Mr. Hawkes, a portable or pocket microscope specially designed by himself; Mr. Madison, a short lecture on "How to distinguish common rocks," well illustrated by specimens that were subjected to various tests to show their nature and composition. MICROSCOPICAL AND GENERAL MEETING, February 4th.—Mr. Moore, a collection of twenty-four beetles found in decaying vegetation. Mr. Madison, *Limnæa palustris*, a large variety from Cheddar, and *Planorbis nitidus*, var. *albida*. Mr. Simpson, a small electric motor for use with turntable. Mr. Dunn, *Chydorus sphæricus*. Mr. Tylar, young of *Gobius niger*, just hatched. Mr. Hawkes, larva of *Corethra plumicornis*. Mr. J. W. Neville, snake's head Coralline (*Anguinaria spathulata*). February 11th.—Mr. Deakin exhibited a collection of wild flowers, showing the mildness of the season. Mr. Tylar, young Starfish (*Asteria gibbosa* and *Stephanoceros eichhornii*). Mr. Moore, gizzard of beetle (*Cetonia lineatus*). Mr. Flower then read a paper, "Notes on Foreign Cage Birds," illustrated by living specimens.

BEDFORDSHIRE NATURAL HISTORY SOCIETY. — A meeting was held at the Bedford Assembly Rooms on Thursday, the 13th inst., Mr. T. G. Elger, F.R.A.S., in the chair. Arrangements were made for printing the transactions, the editorship of which is ably carried out by Mr. Elger. An invitation was sent to the Northampton Natural History Society to join our own upon some date, and at some suitable place to be afterwards agreed upon, for a field excursion. Mr. Arthur Ransom, the botanical secretary, expressed his willingness to conduct a series of Saturday afternoon botanical expeditions during the summer. The Secretary of the Rural Lecturing Committee (Mr. Hamson) announced that lectures had been delivered at Kempton by the Rev. J. Copner and Mr. Crick, and at Great Barford by Mr. A. Ransom. An application for a lecture was received from Potton, and Mr. Hamson agreed to give one on "Flowers and their Fertilization." A paper on "Vegetable Cells and their Contents" was then read by Mr. Hamson, describing the formation, nature, and function of protoplasm, starch, and its derivatives, chlorophyll, crystalloids, globoids, aleuronegrains, the albuminoids, raphides, etc. Mr. Davis lent two microscopes, and an admirable series of slides illustrating the subject, together with a live plant of *nitella* showing the circulation in the cells. At the close, on the proposition of Mr. Elger, seconded by Dr. Adams, and supported by Mr. G. Hurst, a vote of thanks was passed to the essayist.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—Two "Gilchrist" Lectures have been given, under the auspices of the Society, during the month:— "The Animals of the Coal Period," by Professor Miall, F.G.S.; and "The Dynamo-Machine," by W. Lant Carpenter, Esq., B.A. The Drill Hall was densely crowded at each lecture. No ordinary meetings of the Society have been held in consequence of these lectures.

NOTTINGHAM NATURALISTS' SOCIETY.—February 5th.—The members of this Society met for the first time in their new and commodious room at the Social Guild, Parliament Street, when Mr. J. J. Ogle read an interesting paper on "The Dispersion of Seeds." After a few introductory remarks, Mr. Ogle said that water and wind were the most evident means of dispersion, then animals, especially birds. The various adaptations of the seed itself, or of its coverings, or of other attachments, for this special purpose were most interesting and instructive. To begin with the contrivances adapted to the wind as the carrying medium. These were mainly wing-like or plume-like attachments. The ash, the elm, the fir, the maple, and several plants of the natural order Umbelliferæ furnished examples of the former kind of expanded attachments to the seed. Great numbers of the Compositæ, such as the dandelion, the goat's beard, and the thistle, and of other natural orders, as for instance the willow herb, the bull-rush, the willow, and the clematis, gave good examples of connections more or less plume-like. In the fir the wing-like appendage was a development of the seed-covering; in the ash it was an extension of the covering of the fruit. In the lime tree there was another kind of wing, which served as a sail to a whole bunch of fruits, being in fact a modified leaf or bract attached along half its length to the main stem of the fruiting branch. The plume-like attachments of the seeds of plants of the natural order Compositæ were modified calyces so contrived as to catch the wind which was to waft the seeds to their resting place. The pappus-like crown of the willow herb was a part of the seed—it was in fact a special development of the chalaza. In the clematis the top of the fruit consisted of a long flexible feathery tail which was simply the style of the flower increased and rendered permanent. The dispersion of seeds by animals was effected in various ways. In some cases the fruit (to use the word in its popular sense) was sweet and succulent, and eagerly sought after by birds, and the seeds were either dropped from their bills during flight, or were voided in an undigested state. The strawberry was well adapted for dispersion by fruit-eating animals, as also were the blackberry, raspberry, cherry, etc. The seeds of edible fruits were chiefly adapted for dispersion by birds, though in the case of such fruits as the hazel nut, squirrels and other animals were the agents. Then, again, there was a large class of hooked fruits, a familiar example of which was seen in the common heriff, or cleavers, the fruit being covered with minute hooks, so arranged as to cling to any animal that touched it. The fruits of the forget-me-not, agrimony, wood-sanicle, bur-parsley, and the enchanter's night-shade, had hooks very effectively arranged for the end in view. Lastly, there was a large class of plants that disseminated their seeds by forces inherent to themselves; the bursting of cells through high tension, the elasticity of some special part, together with hygrometric action upon the tissues and fibres, resulted in little explosions which threw the seeds a considerable distance from their birth-place.

Instances of this inherent force were seen in the squirting cucumber, in the *Ecballium agreste*, in the *Impatiens noli-me-tangere* and in plants of the natural order Geraniaceæ.—February 7th.—The Annual Dinner of the Society took place at the George Hotel, under the presidency of Dr. E. Seaton. The Mayor (Alderman Manning) and the Sheriff (Councillor Cleaver) and upwards of fifty members and friends were present, and spent a most enjoyable evening.

NOTTINGHAM WORKING MEN'S NATURALISTS' SOCIETY.—Annual Meeting, February 4th, 5th, and 6th.—On the 4th Mr. W. Watchorn read a paper on the "Life History of the Emperor Moth," explaining the stages from the egg to the perfect insect. This moth was taken very plentifully a few years ago by Mr. Watchorn and Mr. J. Fox in Newstead Park, but no specimens can now be obtained . On the 5th the Annual Exhibition was held, when there was a good gathering and an interesting local exhibit by the members. On Wednesday the 6th, the Annual Dinner was held, Mr. Haynes in the chair, Mr. Morley vice-chair. After the usual toasts the yearly report was read by Mr. Goldsmith, Secretary, showing the healthy way in which the Society has worked for the past nine years, having now a valuable library of 100 volumes, a microscope, entomological and large bird cabinets, and other scientific appliances for the instruction of the members.

TAMWORTH NATURAL HISTORY SOCIETY.—On Monday, Jan. 14th, the prizes were distributed to the junior members of the Society. Amongst others, a special prize was offered by the Rev. Brooke Lambert for the best explanation of the following lines from Milton, with any remarks on the word "indented," the explanations to be accompanied with a map:—

"Rivers, arise! whether thou be the son
Of utmost Tweed, or Ouse, or gulphy Dun;
Or Trent, who like some earth-born giant spreads
His thirty arms along the indented meads;
Or sullen Mole that runneth underneath;
Or Severn swift, guilty of maiden's death;
Or of rocky Avon, or of sedgy Lee;
Or coaly Tyne, or ancient hallowed Dee;
Or Humber loud that keeps the Scythian's name;
Or Medway smooth, or royal towered Thame."

Miss Gilbert and Master S. R. Cope were each awarded prizes, Mr. Lambert considering their papers of sufficient merit. Very satisfactory progress is being made in this junior branch of the Society; the numbers are increasing, and the members show interest in their work.—On Monday, the 28th, Mr. E. D. de Hamel gave a lecture on "Air." The lecture was cast in a popular form, with original diagrams and experiments. Dividing the subject under the three heads of "Mechanical Qualities," "Chemical Qualities," and "Effects on Life," the lecturer amusingly illustrated the five governing laws from a scene at the hustings in an old-fashioned election.—On Feb. 11th the Rev. W. Robinson gave his lecture on "Life beneath the Waves." It included notices of sea anemones, star-fish, annelids, the echinas, trochus, octopus, etc. Excellent diagrams, drawn for the purpose by Mr. Robinson, were shown in illustration. The chair on each occasion was occupied by Mr. W. G. Davy, president,

Plate II.

Fig. 1.

Plan at Surface

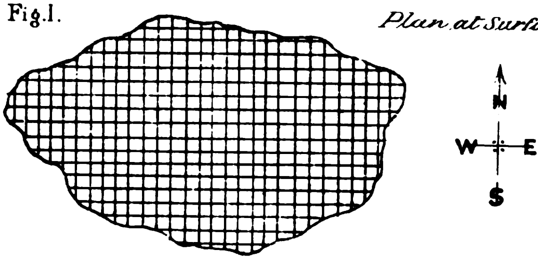


Fig. 2. *Vertical Section at Commencement.*

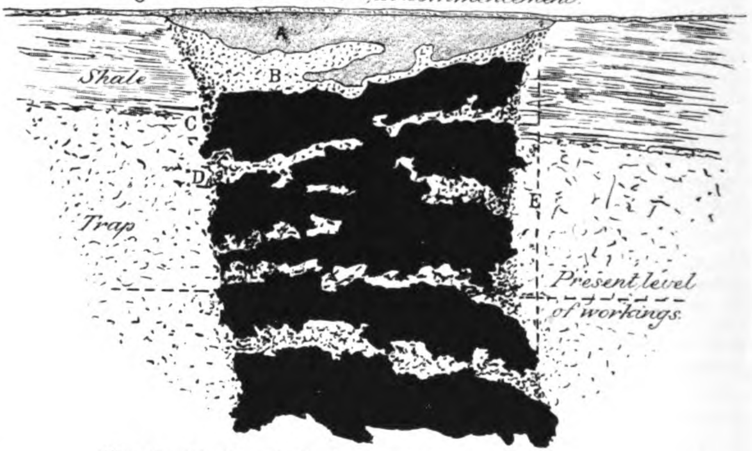
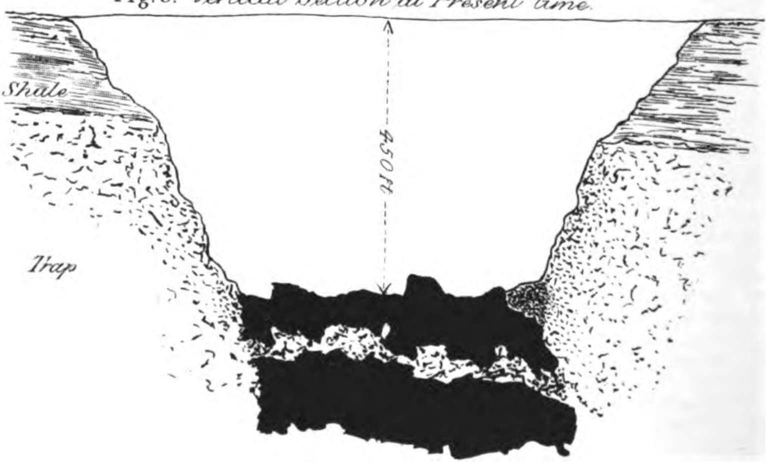


Fig. 3. *Vertical Section at Present time.*



KIMBERLEY DIAMOND MINE.

NOTES ON THE GREAT KIMBERLEY DIAMOND MINE.*

By W. P. Marshall, M.I.C.E.

The diamond field of South Africa is situated in the northern part of Cape Colony, adjoining the Orange Free State and the Transvaal; at about 400 miles distance by road and railway from the south-east coast at Port Elizabeth, and about 650 miles from Cape Town on the south-west coast, the capital of the Colony. This district is quite unique, and the most remarkable one known for the produce of diamonds and for the circumstances of the ground in which the diamonds are found, and there are several points of special interest connected with it.

Besides the Kimberley diamond mine there are three others in the immediate neighbourhood—Du Toit's Pan, De Beers, and Bultfontein; these are larger in surface extent than the Kimberley mine, but the latter is the one of most importance, and has been worked to the greatest depth and in the most systematic manner. There are also two other diamond mines in the Orange Free State, at about 40 miles distance from Kimberley.

The Kimberley mine is worked by a number of diamond mining companies, under conditions from the Government of the Colony, and now forms a great conical pit of irregular outline 450ft. deep and nearly a quarter of a mile across at the top. In Plate II. is shown an approximate sketch of the vertical section and plan of the mine; and this drawing and the following paper have been mainly prepared from information supplied by Mr. H. Kenneth Austin, who has recently returned from the district, having been engaged upon the Cape Government Railways.

Fig. 1 is a plan showing the division into separate claims.
Fig. 2 is an approximate section of the mine at the beginning of the working.
Fig. 3 is a corresponding section at the present time, showing the 450ft. depth of excavation of the mine.

The first diamonds of the South African field were found sixteen years ago in the bed of the River Vaal, near the border of the Transvaal State, and in adjoining ground washed by mountain streams forming sandy and gravel deposits in which diamonds were picked up. These "River Diggings," and the searching of the top gravel on the river banks, were carried on for some years in that locality, at about twenty-four miles north of Kimberley; and extended irregularly

* Transactions of the Birmingham Natural History and Microscopical Society. Read February 26th, 1884.

along the River Vaal in both directions over a total length of 200 miles. Afterwards, and about twelve years ago, the bed of "diamantiferous stuff" forming the surface portion of the Kimberley mine was discovered in the middle of a farm belonging to a Mr. Ebden; and near the same time similar discoveries were made on three other farms in the neighbourhood, resulting in the present four diamond mines, all within two or three miles of Kimberley.

The Kimberley mine was bought by the Cape Government, and the surface was allotted out to the numerous diamond miners in separate claims of ten yards square each, as shown upon the approximate plan Fig. 1, Plate II., making upwards of 400 claims altogether in this one mine, for which a royalty of 10s. per month is paid for each claim. Sometimes a claim is subdivided again amongst several persons; but in some cases a number of adjoining claims have been united by purchase into one company, for obtaining the facility and economy of combined working; in the most important of these cases as many as twenty-seven claims are united in one working.

The original "diamantiferous stuff" (A, Fig. 2) was a loose yellow gravelly soil, partly calcareous, and covered by only 2ft. or 3ft. thickness of red surface soil; it was removed by Kaffirs with wheelbarrows and carts, and conveyed to depositing ground beyond the margin of the mine for washing and sifting. This stuff continued to a depth of from 60ft. to 100ft., containing a large number of diamonds of various sizes, and the stuff was valued at 10s. to 20s. per load of 16 cubic feet. But this mine of wealth then came to an abrupt stoppage, and the diamantiferous stuff was succeeded by a floor of hard trap rock (B), that seemed to form a hopeless termination to the workings, and caused most of the miners to give up in despair. A few, however, stuck to their claims and determined to sink on into the trap rock with the hope of piercing through it; and they were ultimately rewarded for their perseverance, after passing through 20ft. to 30ft. thickness, by coming upon another deposit of "diamantiferous stuff" (C) that proved even richer in contents than the upper deposit, and was valued at 20s. to 80s. per load. This deposit, which is known as the "Blue" stuff in distinction from the "Yellow" stuff of the upper deposit, is a hard tough breccia of a bluish slaty colour, requiring blasting for quarrying it. It is looked upon as an eruptive rock, and is of a very remarkable and unique composition, containing great quantities of broken pieces of shale, boulders, and different kinds of basalt. It occurs in irregular masses or "pockets," which are separated by intrusions of trap rock (D) called "Floating Reef" by the miners. The whole is surrounded by trap rock called "Main Reef," as shown in Figs. 2 and 3, and this commences at about 170ft. to 200ft. from the surface, and the portion above the trap is a loose shale with some intrusive trap. These upper strata have proved very treacherous, and several serious slips of the sides of the mine have occurred; the worst of these slips has recently taken place, and is so serious in extent that the whole of the workings at the bottom are blocked up by the fallen material, and the progress of the mine is entirely stopped until this can be removed, which may require several months time. The result of this accident is a very serious check to the prosperity not only of the mining district but of the Cape Colony itself and the Government railways, from the loss of the traffic for the supply of materials for the mining works, and for the support of the large population gathered round the diamond mines. The distance of about 200 miles from Kimberley to the present railway terminus has to be traversed by bullock waggons, which are the only means of conveyance in the Colony where railways do not exist, excepting a ten-horse coach that runs between Kimberley and the railway terminus for passenger traffic.

The town of Kimberley, which has now 10,000 or 15,000 inhabitants, extends round the margin of the great pit forming the Kimberley mine, the earlier buildings having been removed by the falling in and enlargement of the circumference of the pit. As the excavations got deeper the original wheelbarrows and carts had to be superseded by horse whins for drawing up the excavated material, and this was carried out by means of a very extensive system of wire-rope suspended railways—wire ropes suspended for long distances in the air, and stretched tight so that buckets on suspending wheels can be run upon the wire ropes like railways, and the excavated material from the claims in the middle of the pit at the bottom is drawn up to the surface over the heads of the other claims. The result produced is a remarkable net-work of wire ropes, like a gigantic spider's web, extending over the entire area of the mine. For the last seven years steam power has been used in place of horse power for the hauling, on account of the increase in depth of the mine, and a large number of steam engines are now fixed round the margin of the pit for hauling and mining purposes. The work of removing the fallen material from slips of the sides of the mine, and of keeping the workings clear from water, is undertaken by the Mining Board, and the cost of this work is defrayed by a tax on the several claims.

The excavated material when brought up to the surface is removed to a depositing ground, a separate ground being allotted for each claim, and the "stuff" is there laid out upon a floor in a layer of four to six inches thickness and watered about every three to six days to cause the material to slack. It is left exposed to the air for a period of four to six weeks and is then passed through the washing and sifting machines, and the contained diamonds are obtained by their settling down at the bottom of the last machine, the diamonds being a much higher specific gravity than any other materials with which they are associated in the stuff; the deposited material is afterwards passed over sorting tables, where the managers and proprietors of the claim pick out the diamonds.

One great difficulty that has been experienced in this washing process has been the scarcity of water in the district and the great difficulty of obtaining the supply of water requisite for the washing of the stuff; the river Vaal being 24 miles off, and the elevation of the whole district more than 3,000ft. above the sea. A Kimberley Water-works has consequently been constructed and started in the last two years, by which water is supplied at the comparatively moderate rate of 1s. per 100 gallons. There has also been, in connection with these diamond mines, a large application of mechanical skill in devising the hauling and washing apparatus for obtaining the best results with the greatest economy in weight of material employed in the construction, on account of the great difficulties and limitation in the means of conveyance to the place; and also for obtaining the greatest economy in the fuel consumed for the engine power obtained, the scanty natural supply of wood in the district having become nearly exhausted and the supply of coal being very costly. Mr. Paxman, of Leeds, has done much in improving the supply of engines and machinery for these diamond mines, and gave a paper on the subject to the Institution of Civil Engineers, from which some of the particulars in the present paper have been obtained.

All claims "fall in" or revert to the Government if the mining licenses and taxes are not continued to be paid; but a very special and almost romantic circumstance to be noticed in connection with the Kimberley mine is that the original allotment of claims being for a definite area, each including all the produce of digging within that area, and not having any limit as to depth of excavation, those of the original claims situated towards the right hand (eastern) margin of the field, although they utterly failed in results after having passed through the top "Yellow" diamantiferous stuff, will now have a good chance of sharing in the most valuable portion of the mine, the "Blue" stuff, on account of the general inclination towards the right hand of the great "pipe" comprising the entire deposit; when the time comes that the general excavation of the pit reaches the required depth, as illustrated by the vertical dotted line (E) on the right of the section, Fig. 2. The claims situated on the left of the original field have lost from this cause all further chance, after sharing in the top yellow stuff.

The great "pipe" forming this mine is looked upon as probably the throat of an ancient volcano, of which the summit cone has been removed by denudation, and the throat has remained filled up with volcanic mud and other material forced up from below, amongst which the diamonds are distributed; and this consideration suggests the possibility of an increased yield of diamonds being found as the workings are carried still deeper. To effect this, however, it will be requisite to have recourse probably to sinking shafts, with regular underground mining work, the practical limit of "open working" having been now nearly reached. The diamonds found are either perfectly pure or more or less coloured, and also the black diamonds called "bort," and, as found imbedded in the material of the "pipe," they generally show evidence of having been exposed to some severe disturbing force, their angles being frequently abraded, and many being fragments fractured from larger stones. One form of the diamonds is known as "splints," consisting of thin plates.

The other three diamond mines adjoining the Kimberley mine and the two in Orange Free State are also of a similar character in natural formation; but the river diggings are of an entirely different character, and the diamonds that are there found in superficial gravel deposits are looked upon as possibly derived from upheaved volcanic material in a higher district of the country that has been denuded and carried down by water action. The diamond fields in other parts of the world are also generally of this latter character, and the diamond mines of the Kimberley district are quite unique in their character, and of special interest as affording some important information towards a knowledge of the source of origin of the diamond. Several other "pipes" have been opened and partially worked in the Kimberley district, but were subsequently abandoned as unremunerative, although some diamonds were obtained; probably by deeper sinking richer yields would have been found.

The Kimberley mines are situated at an elevation of about 4,000ft. above the sea, and the range of mountains, the

Draakensberge, on the slopes of which the Vaal river has its source, rise to 10,000ft. above the sea. It is a point of interest to notice that the new gold field in the Transvaal is within about 500 miles of the Kimberley diamond mines, in a north-east direction, and is at a level about 3,000ft. higher, or 7,000ft. above the sea.

METEOROLOGICAL NOTES.—February, 1884.

The barometer was low at the commencement of the month, but rose an inch in two days, reading on the 3rd 30·395 inches, its highest point during the month ; from this it fell steadily, with dull weather, to the 9th, when it rose till the 14th. A gradual fall, till the 23rd, was succeeded by another rise, till the end of the month. Slight gales were experienced about the middle of the month. Temperature was nearly 2 degrees above the average, though lower than that of January. The mean of maxima, 47°.4, differed but slightly from that of January, but the mean of minima was 2°.3 lower. The lowest air temperatures (4 feet) were 21°.6 at Hodsock, 25°.5 at Strelley, and 26°.3 at Coston. On the grass the thermometer fell below 32°.0 on thirteen nights, a minimum of 15°.2 being recorded at Coston on the 29th. The maxima varied from 52°.7 at Strelley, to 55°.1 at Loughborough. Rainfall was decidedly below the average ; there was no snow, but slight showers of graupel (soft hail) fell on two or three occasions. There were no special features of interest during the month, but, being comparatively mild and dry, vegetation did not receive any of the checks to which it was exposed in its very forward state.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street,
Loughborough.

Mr. Clement L. Wragge, the well-known astronomer, is about to start an astronomical and meteorological observatory on the banks of the Torrens, at Gilberton, South Australia, observations to be commenced on 1st January, though the preliminary operations will not be fully completed till some days later. An astronomical telescope, one of Wray's finest equatorials, with object glass 4½ inches in aperture, has yet to be unpacked and mounted. Numerous appliances have been provided. The house will be called the Torrens Observatory.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER III.

The Re-actions of Organic Matter on Forces.

BY FREDERICK JOHN CULLIS.

This chapter is very intimately related to the two preceding ones, concluding the argument opened in them. In Chapter I. some important aspects of the physical and chemical composition of organic and organisable matter are considered, and it is found that such matter is extremely susceptible of change. Chapter II. discusses the action of force on these changeable substances, and shows how, in the leaves of plants, matter is compounded into potential forms by the accumulated effect of multitudes of infinitesimal etherial impacts; and that in the tissues of animals, under the catalytic action of ferments, these complex bodies are again reduced to simpler forms. In Chapter III. we are shown that these changes of matter are accompanied by equivalent changes of force. Perfect symmetry of the argument would have demanded a discussion of that accumulation of energy which accompanies the building up of food-stuffs in the green parts of plants, and of the manifestations of force which result from the decomposition of matter in the tissues of animals. But only the latter series of phenomena are considered on this side of the argument.

It is shewn successively that this manifestation of force occurs—

(A.) *As heat.* It being a chief characteristic of animate bodies that they maintain a constant evolution of heat, the quantity of which is strictly dependent on the amount of organic matter decomposed by the organism.

(B.) *As light.* Though less conspicuously than heat, light also is sometimes given off by animals as a partial result of the liberation of force in their tissues; the phosphorescence of some insects and marine animals being well-known phenomena.

(C.) *As electricity.* Which is found to be constantly generated in the ordinary structures of the higher animals, as well as in the special organs of electric fishes.

(D.) *As nerve force.* This is also seen to be dependent on the same breaking down of complex substances.

(E.) *As sensible motion.* The most evident of the "reactions called forth from organisms by surrounding actions." This manifestation of force is not confined to the Animal Kingdom, being commonly exhibited by certain of the humbler plants, as well as in the circulation of the sap in higher forms. Mechanical motion is nevertheless specially characteristic of animal life, and in its highest manifestations is always effected by the contraction of muscle under the impulse of nervous stimuli. Mr. Spencer suggests that the important changes involved in the contraction and relaxation of muscle may be explained by the repeated occurrence of an isomeric change in its molecular constitution.

ANNUAL MEETING OF THE UNION.

The Midland Union of Natural History Societies will this year travel to the eastern verge of its district, in accordance with the invitation of the Peterborough Natural History Society. The annual meeting will be held at Peterborough probably in the latter part of June, and very attractive excursions are being arranged by the local committee. Situated on the border of the Fens, yet surrounded by excellent and remarkable sections in the oolitic strata, Peterborough offers attractions of a high order to the botanist, the entomologist, and the geologist, while the archæologist can revel in the buildings and churches of the town and neighbourhood. We trust that the members of the Union will muster in large numbers to avail themselves of such an excellent opportunity of exploring "fresh scenes and pastures new" under able and judicious guidance.

YEAR-BOOK OF SCIENTIFIC SOCIETIES.—Messrs. Griffin & Co., of Exeter Street, Strand, have in hand a work which will give much information respecting the scientific and learned societies of Great Britain. It will be edited by Mr. W. R. Browne and Mr. Barclay. Secretaries of societies in the Midland Union should at once put themselves in communication with Messrs. Griffin, who will forward them a form containing the points on which information is desired for publication.

ON THE INTERCELLULAR RELATIONS OF PROTOPLASTS.—II.*

BY WILLIAM HILLHOUSE, B.A., F.L.S.,

PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY AT THE MASON SCIENCE COLLEGE, BIRMINGHAM.

[*Continued from page 66.*]

Sieve Tubes.—The existence of open communication between certain cells of the higher plants, namely, between the different anatomical elements which compose sieve tubes, and between adjoining sieve tubes, has been for many years well known. Attention was first drawn to these structures as forming a constituent of the bast portion of the fibro-vasal bundle of at least the phanerogams by Th. Hartig † in his great work on the native trees of Germany, and to them he gave the name of "Siebfasern." Little attention, however, appears to have been paid to these structures until after the publication by the same investigator many years later of a detailed account of this tissue in *Cucurbita Pepo.*‡ The subject was then taken up by the distinguished morphologist, von Mohl,§ whose influence at that period preponderated in all branches of vegetable anatomy. Von Mohl first proved the existence of sieve tubes in Gymnosperms, denied by Hartig. Little actually new was, however, added until Nägeli|| demonstrated that the sieve plates were actually perforated, a fact confirmed by Sachs¶ and further by Hanstein,** by means of the now classical method of treatment by iodine and sulphuric acid, showing clearly the existence of protoplasmic

* Transactions of the Birmingham Natural History and Microscopical Society. Read March 18th, 1884.

† Th. Hartig, "Vergl. Untersuchungen üb. d. Organisation des Stammes d. einheimischen Waldbäume," 1837.

‡ Th. Hartig, Bot. Zeit., 1854, pp. 51—4. The same author had previously referred to these structures in "Vollst. Naturgesch. d. forstl. Culturpfl.," Berlin, 1851, and Bot. Zeit., 1853, p. 571.

§ Von Mohl, "Einige Andeutungen üb. d. Bau d. Bastes." Bot. Zeit., 1855, p. 865, f.f. For proof of presence of sieve tubes in Gymnosperms, see p. 891.

|| Nägeli, "Ueber d. Siebröhren." Sitz. d. Bair. Akad., 1861, I., p. 212.

¶ Sachs, in "Flora," 1863, p. 68.

** Hanstein, "Die Milchsaftgefässe u. verw. Organe," 1864, p. 23, ff.

threads permeating the sieve plate, and connecting together the protoplasmic body of the constituent cells of the sieve tube.*

Several investigators have since turned their attention to the same deeply interesting point of structure, amongst whom Dippel † first demonstrated the presence of similar anatomical features in Vascular Cryptogams, and enriched science with a series of most carefully drawn figures from different plants; while Russow ‡ gave details of the forms of the tubes in different plants of the same groups, distinguishing, with Dippel, two main forms to which he gave the names of Siebröhren (sieve tubes) and Siebgefässe (sieve vessels). By far the most important researches up to their date were, however, those of de Bary, § published in his great work on the comparative anatomy of the vascular plants, to whom is due the merit of first drawing systematic attention to the contents of the tubes, although Briosi || had previously pointed out the very frequent presence of starch in the tubes, and had declared that he had by pressure forced the grains through the pores of the sieve plate. De Bary also first showed, in the case of the vine (*Vitis vinifera*), the absence of the sieve perforation during the winter months.

Within the last two or three years the study of sieve tubes has entered into a new phase, and they have formed the subject of several excellent monographs, in which they have been dealt with mainly from a developmental point of

* For further early literature:—

Th. Hartig, "Die Entwickelung des Jahrringes." Bot. Zeit., 1853, p. 571, ff., already referred to.

Franck, "Ein Beitrag zur Kenntniss der Gefässbundel." Bot. Zeit., 1854, p. 159.

Schacht, "Der Baum." 3rd Aufl., 1860. Schacht distinguishes here three types of sieve tubes in Phanerogams; (1) Tubes transversely divided by simple sieves; (2) Tubes terminated by oblique partitions and provided with several sieves; (3) Fusiform tubes having sieves also on their radial walls. See pp. 208—15.

† Dippel, Bericht der 39. Naturforscherversammlung zu Giessen, 1864. See also "Das Mikroskop," II. Theil, pp. 132, 199, 200, and Figs. 54 and 150 to 155.

‡ Russow, "Vergl. Unters. üb. Leitbundel-Kryptogamen, 1872, p. 118, ff.

§ De Bary, "Vergl. Anatomie der Phanerogamen und Farne," 1877, pp. 179-191, and many figures.

|| Briosi, "Sopra la Generale Prezenza d'Amido nei Vasi Crivellati." Nuovo Giornale Botanico Italiano, Vol. vii. (1875), pp. 83-108, and plate.

view. First of these came the investigations of Wilhelm,* who, although he studied but three plants, viz., *Vitis vinifera*, *Lagenaria vulgaris* (the Gourd), and *Cucurbita Pepo* (Pumpkin), followed out in them the history of these structures with such care and fidelity as to place him high in the rank of sieve tube investigators. He more completely stated the dependence of the perforation on the seasons. Russow,† whose earlier work we have already referred to, has widely and critically extended his observations in two memoirs of much intrinsic importance; while another of the highest value is that of the Polish observer, Janczewski.‡

Sieve tubes, whether perforate or imperforate, must be therefore looked upon as the essential constituent of that part of the fibro-vasal bundle of plants which morphologists variously call the liber, bast, or phlöem. They have been, however, most completely studied in the Angiospermous Phanerogams.

Typically, sieve tubes are composed of elongated cylindrical or prismatic cells, arranged end to end in longitudinal rows which traverse the entire length of the plant, sometimes isolated amid a different tissue, sometimes collected into groups, bundles, or layers. On this isolation or otherwise of the sieve tube depend important morphological results; for, when the tube is isolated amidst parenchymatous tissue, the perforations, where they exist, are only between the constituent cells of the row, the sieve plates and perforations are only terminal; where, on the other hand, two sieve tubes are in lateral contact the sieve plates and perforations establish communication also between these lateral rows, *i.e.*, are both terminal and lateral. One further point of morphological interest may be noticed. The constituent elements of a single sieve tube may join end to end by approximately horizontal partition walls. Then, as in Cucurbitaceæ generally, a cross section of the part containing the tubes will show the whole or nearly the whole of some sieve plate in surface view. Such a surface view of the sieve plate of

* Wilhelm, "Beiträge zur Kenntniss des Siebröhrenapparates dicotyler Pflanzen," Leipzig, 1880.

† Russow, "Verbreitung der Callusplatten bei den Gefässpflanzen," Sitz. der Naturf. Gesellsch. zu Dorpat, 1881, and a recent memoir in the same, of date Feb., 1882, translated into Annales des Sc. Nat., 1882, series vi., tome xiv., pp. 167—215.

‡ Janczewski, "Etudes comparées sur les tubes cribreux," Mém. Soc. des Sc. Nat. de Cherbourg, xxiii., 1882, p. 209, etc., with eight double plates; reprinted in condensed form in Ann. des Sc. Nat., ser. vi., tome xiv., pp. 50—166, with six single plates.

Bryonia dioica is shown in Plate III., fig. 1. When, on the other hand, the constituent cells are fusiform, and join by more or less strongly overlapping ends, the walls separating the constituent cells, and consequently the sieve plates which are formed on and in these walls, are oblique in greater or less degree (*e.g.*, *Vitis*,* and the great majority of sieve tubes). In such cases a cross section will naturally not show the sieve plate, or will only show an often unrecognisable fragment of it, and longitudinal sections are the only ones by which they can be studied in surface view.

Variously constituted as sieve plates are, they show one apparently constant feature, to which Hanstein was, I believe, the first to draw attention, but which Russow has, in the second of the memoirs above referred to, thoroughly studied, as also, though to a lesser degree, did Wilhelm and Janczewski. This is the presence on the plate of a substance called *callus*. The normal wall of the sieve tube is soft and colourless, colouring blue with iodine and sulphuric acid, or with chlorzinc iodine, and therefore of pure cellulose. The end, or sieve walls, show, however, a different structure. The wall is manifestly thickened, and with a substance which does not give the above cellulose re-actions, nor does it dissolve in ammonia cuproxide. On the other hand, this substance possesses certain marked re-actions: with a solution of Rosolic acid (corallin) in soda or ammonia † it takes a beautiful rose-red colour, a colour, however, of unfortunately but brief duration. This reaction shows the substance to be a transformed cellulose of a mucilaginous nature; aniline blue, a colour which is not retained by cellulose, is fixed by this substance (Russow); aniline brown is also fixed; a mixture of chlorzinc iodine and potassium iodide iodine in varying proportions colours it of a deep reddish brown and shows also any variations present in its structure; ‡ and the same end I have attained with success by first treatment for a few minutes with potassium iodide iodine, and then for twenty-four hours or so with chlorzinc iodine, and without needing to vary the proportions so carefully from plant to plant. Of all these re-actions the corallin and iodine ones are the best, but unfortunately both are ephemeral, though the latter will last with care for days in all its pristine delicacy. The coloration by aniline blue, though apparently permanent, is generally of comparatively little use, as it is accompanied by

* In *Vitis* the sieve plates are occasionally horizontal.

† See Szyszylowicz, in Bot. Centralbl., 1882.

‡ Russow, Sitz. d. Dorp. Naturf. Ges., 17 Feb., 1882.

the great swelling of the thickening substance and obliteration of its clearly marked outlines. This thickening substance is the callus. The walls thus thickened are perforated by the canals of the sieve pores, the pores being distributed over a limited area. Most commonly, markedly in very oblique sieve plates, a number of such areas are side by side, separated by narrow bands of unmodified cell-wall. When, on the other hand, the cells composing the tube join by nearly horizontal ends, the whole end wall forms a single area (or, according to Janczewski, it, in Vitis, frequently consists of a number of areas).* This condition is the normal one in the great horizontal or but slightly oblique sieve plates of Cucurbitaceæ (Plate III., fig. 1), in *Æsculus*, *Acer*, etc.

(To be continued.)

THE HERON *(ARDEA CINEREA)*.

BY T. V. HODGSON.

The progress of agriculture has made itself severely felt on the majority of birds, but no order has suffered so much as the Herodii. Several species of this order were formerly common in Britain, and some, in days of yore, considered the noblest quarry of the falconer, a sport which has now fallen into disuse though still occasionally followed.

The large tracts of marsh land reclaimed and cultivated in these more modern days has driven nearly the whole of this order from our shores, and what agriculture has spared the gun remorselessly exterminates. The Broads of Norfolk and Fens of Lincolnshire form almost the only homes of any space left to these birds, and the former are infested with gunners, ever ready to slaughter some uncommon bird; consequently few of these birds are seen, and those merely stragglers from a foreign country. One species, and only one, the Heron, seems to have made a comparatively successful struggle against extermination, though constant persecution has rendered it a very wary and a local bird.

The existence of a small Heronry at Middleton, four miles from Tamworth, has given me a good opportunity of watching these birds, and I have endeavoured to make use of it, obtaining many a pleasurable hour thereby. The Heronry is not more than two hundred yards from the Hall, and occupies one end of a wood intersected by a cart-track and

* Wilhelm (l.c.) thinks this occurs but rarely.

two or three broad ditches containing but little water. Brambles and elder bushes form the underwood and surroundings. Some little time back a strong gale blew down a large number of trees in close proximity to the Heronry, leaving a large open space, which however, has recently been replanted, and the birds still cling to their accustomed haunts. The nests of the birds breeding in this locality are built in the tops of tall trees, some forty or fifty feet high, and though something like thirty or forty birds occupy the wood during the breeding season, since I have known the Heronry I have never seen more than nine nests at one time. Year after year I have noticed four or five nests left incomplete, for what reason I cannot say; but for its occurring so regularly I should have put it down to the death of one of the old birds, as, in a neighbourhood like Middleton, some one or other is always prowling about with a gun. Chambers, the gamekeeper of the estate, tells me that a little nest-building is done at intervals through the summer, but I have never witnessed it after the usual time.

All through the winter two or three Herons remain at Middleton, and, scouring the district round in search of food during the day, they always return home for the night. Towards the end of February a large accession to the winter residents is made by the arrival of the first migratory flock. A second flock arrives a week or so later, and not unfrequently a third later still. Nest-building is begun soon after the arrival of the first flock, but very little real work is then done, most of the time being spent in fighting and the systematic robbery of each other's materials; these qualities seem highly developed at this season, and are scarcely to be surpassed even by the Rook. Frequently high winds retard building operations, the demolition of a half finished nest being not at all a rare occurrence; but when the birds set to in earnest, two or three days suffice to complete a massive structure. Like the Rook, the Heron repairs the ruins of the old nest and occupies the same site for years. The eggs are laid in the middle of March and a month later the young are hatched.

The Herons were very wild during my first visits to the Heronry. A harsh cry, and the loud flap of their large wings striking the smaller branches of the trees on which they were reposing, the moment I entered the wood, showed that they were on the alert, and I seldom saw them again till after going some distance from the spot. One bird, but occasionally more, usually acted as scout to the colony, and the whole time I was there it sailed round and round, occasionally uttering a harsh cry. I always carried a powerful opera-glass with me, so that I could see the bird distinctly; its head was then thrown back on its shoulders, and its long legs stretched out behind, both the latter being frequently called into play for steering the bird on its course; as a rule, only one is used at a time. Sometimes, managing to hide myself and waiting some time, I could see the Herons coming slowly back and settling on, or near, their respective nests, but the moment I showed myself away they went. As my visits became more frequent many of the birds would remain where they were, but even then their actions betrayed their suspicions.

Not far from the Heronry are two rather extensive Rookeries, the tenants of which do not seem to be on good terms with their less numerous but more powerful neighbours. On April 6th, 1882, as I was in the Heronry with the gamekeeper, he told me that a fortnight before some Rooks attacked a nest and destroyed the eggs. He pointed out the nest as we passed under, and I saw a Heron then sitting on it; the egg shells lying underneath bore only too evident traces of the spoliation. Another of my notes (Feb. 25, 1883) says "after leaving the Heronry I looked back, and with my glass I saw the flock of fourteen Herons approach the wood, wheel round, and retire. One bird was apart from the rest, being attacked by a Rook or some other bird, but what I could not make out on account of the distance."

Last year, on the third of April, with an eye to enrich my Oological collection, I attempted a raid on a nest, which, after a stiffish climb, I reached; it only contained two eggs which were of a beautiful greenish blue colour and about the size of a Wild Duck's. The nest measured about 3 feet in diameter and 20 inches thick (my measurements would have been more accurate but for my awkward position). It was nearly flat, and very compactly built of sticks and small branches, and the eggs were reposing on a lining, if such it may be called, of very coarse grass and roots. The bird did not forsake the nest, for when I was in the Heronry on the 20th inst. I saw the old bird on the nest. Egg shells were lying under the remaining eight nests, and under one of them was the corpse of some adventurous young one about a week old. On May 1st the keeper told me that his son had five eggs out of the nest from which I had taken my eggs. The supposition that the Heron makes two holes in its nest for the accommodation of its long legs is too well known to be erroneous to need a fresh denial here, though it is still believed in by some people in the neighbourhood. Many of the people don't seem to know what a Heron is, the local name being Crane.

Adjoining Middleton Hall is a large pool of some twenty or thirty acres in extent. It is supplied by a fair-sized stream, which, on leaving it at the other end, runs into the river. The pool is very shallow and forms the haunt of many species of waterfowl.

The food of the Heron is principally fish, young birds it is not at all averse to, chickens not excepted, while frogs and water rats are freely devoured.

These fine birds meet with but little sympathy in the district. In search of food they are seen many miles from Middleton, and are remorselessly shot down by gamekeepers and prowling gunners all over the neighbourhood, even at Middleton itself. One bird, which the keeper shot, I dissected and found in its stomach a fair-sized trout only just swallowed; the remainder of the stomach's contents was so far digested as to be unrecognisable. The keeper told me that the Herons had destroyed £40 worth of young trout in a few weeks. This accusation seemed to me quite unfair, and I raised my voice in their favour, but it was useless. While the trout were disappearing, no less than eight swans were committing their depredations with impunity. People think the swan is a beautiful bird to ornament a sheet of water, and for this reason its protection is secured. Beauty covers a multitude of sins, and other birds, though equally beautiful, if not more so, which do not strike the eye of the superficial observer, are condemned to extermination for a fault, which to a great extent they have not committed. There is no doubt these birds destroy a large quantity of fish, but, though they can both swim and dive, I have never heard of them catching fish by any other method than that of standing motionless in shallow water, when a sudden dash at the unsuspecting victim seldom fails to secure it. From this cause the depredations of the Heron must be very circumscribed, deep water affording a comparatively safe refuge for the fish. The shallowness of the pool and the aid of eight swans would account for the speed with which £40 worth of trout disappeared, as the bird would doubtless live most freely on what was easiest to obtain. As deep water affords a protection for the fish, I should certainly not consider the depredations of this bird of sufficient weight to justify its slaughter, more especially as fish do not form the whole of its diet, rats being freely devoured, and it must be confessed these are a terrible plague. Whatever its faults are, the Heron's stately flight, and its interesting colony in the breeding season, add a charm to the country scene worthy of admiration by the lover of Nature. While boating daily down the Tame I almost always roused up two or three of these birds from the island known as Broad Meadow, and watched them wend their flight sometimes towards Middleton but often in a contrary direction.

This is the last species that is anything like common in Britain of a noble order of birds. Let not this handsome bird be banished from the country in which it has struggled for existence so long. As soon as a bird becomes rare, the few individuals that are seen are instantly shot to adorn some museum, and the note of their occurrence is also the note of their death. A large proportion of our British birds are in this plight, and I am afraid the number is increasing. Many naturalists complain, but hitherto little or nothing has been done to stop it.

THE BASALT OF ROWLEY REGIS.

I.—THE OCCURRENCE OF GROOVED AND STRIATED STONES ON THE ROWLEY HILLS.

BY C. BEALE, C.E.

A stranger passing along the many pleasant roads and footpaths of this elevated district could not fail to notice on every hand the long lines of fence walls built of dry stones, loosely, but securely, placed without mortar. Some of these walls are of considerable magnitude, being from eight to ten feet in height, five or six feet in thickness at bottom, and a couple of feet thick at top; but the ordinary size of the walls is about five feet high, three feet thick at base, and eighteen inches at top. The stones comprising these walls vary in size from huge blocks of, perhaps, a ton weight, or even more, to the ordinary size of twenty-eight or thirty pounds in weight.

Generally speaking, these walls show signs of age. Sometimes the roots of growing trees firmly clasp a number of the stones in an everlasting embrace. Sometimes the ferns of many generations have quite filled the interstices between the stones, and again, in favourable aspects, whole ranges of fences will charm the eye by their covering of many-tinted lichens and mosses. In cases like these we might be justified in assuming that such walls had been in existence for one or even two centuries, and we have walls of all ages down to those built within the last few years.

The whole of the stones composing these walls—both the old and the new—have one common origin. They are *all* basalt. They are all natives of these Rowley hills, and, as a rule, we see them exactly as they have been found, that is, they are not stones from the quarry, but have, each one and all, been got from the surface, or just below the surface, in the ordinary agricultural operations of the last few centuries, and they are still being picked from the land year by year in very large quantities.

These stones are not boulders. You could not find a *rounded* stone among them if you were to search the whole year through. There is not a *foreign* stone among them, therefore they are not erratic blocks, but are all natives of the hills on which they are found. They are all angular and subangular, some indeed with the angles as sharp as when they were first detached from the parent rock; but all are somewhat weathered, not in the sense of becoming disintegrated or rotten, but in the same way that joints in the actual mass of rock in the quarry are weathered—that is, the surface is discoloured for a depth of about the twentieth or sixteenth of an inch by the contact of air and moisture. Indeed, this surface colour completely enveloping our native blocks is the chief difference between these stones and any similar heap of stones in the quarry resulting from a recent fall or the usual quarrying operations.

The largest of these stones are usually found on the tops, for a very little, if at all, below the shoulders of the hills. Lower down we get stones of less size; near the base of the hills we get the smallest stones, while around the base on almost every side we get the famous blue brick marl, being the final stage of the *débris* of the hill tops.

I say around the base on *almost* every side advisedly, because in at least one locality we get a production entirely different to the marl, to which I shall refer hereafter. Now let us examine any of the walls about us; and we soon remark a *grooved* stone, and close by another, and if we were to go on with our examination for a day we should find that we had noted hundreds of the stones similarly grooved and scratched as we went along the walls. And now we come to a field where a man is ploughing, and we follow the plough with him for a while, observing while we talk with him. We see that occasionally the plough turns up a stone of three or five or seven pounds' weight, and we ask him what would happen if the plough struck a larger stone a fair blow. He will tell you that it would knock the plough out of his hands and perhaps break it. At last, however, you hear the plough grating along a stone, and the ploughman may tell you that he knew of a big stone being about there and he eased the plough up a little so as to go over the stone instead of striking it full tilt. You immediately fall behind, and with help of hands and hammer you succeed in baring the stone, and you find that the plough has left no mark of its passage over it; but, strange to tell, you may find the stone grooved and scratched, it may be at right angles to the direction of the plough. This sets you thinking, and on examination of the plough you find there is no part of it that could by any possibility in passing over a stone mark it with the grooves or striæ you have just seen on the stone *in situ* or on those you had examined in the walls. Not satisfied with your partial examination of the stone you uncovered, you may desire to unearth it altogether, and, having got the necessary permission and bared the stone completely, you find yourself in possession of these facts:—You see a stone weighing half a ton or a ton, a stone that could not possibly be moved by any agricultural operations that had ever taken place above it; you find it grooved in about a north and south direction, not only on the uppermost side but you find the grooves on other sides also; and you even trace one groove going across the stone in a connected manner over an angle and across another side, and this, remember, is a stone *in situ* which no agricultural implement could move if it struck it. How then has it come about that these curious markings are exhibited, and sometimes continuously on more than one face? We have no positive evidence as yet enabling us satisfactorily to reply to this query, but the negative evidence would lead us to confess that these marks were *not* made during the course of agricultural operations.

To be able to read these markings correctly we must go below the surface. We therefore visit the sections exhibited in the various quarries upon the hills, and we may sum up briefly the result of our observations thus. Taking the sections of the quarries on the north and east sides of the hills, we find below the surface soil, generally about thirteen inches in depth, a mass of dry rocky material, which breaks up into small cubical morsels in the hand without any difficulty, and this material obtains until you get down to the basalt itself, at depths varying from two to four, ten, twenty, and even one hundred feet. You can scarcely find a stone throughout the entire area; but directly we turn the southern shoulder of the hill a totally different class of facts confronts us. We have the surface soil as before, but we have no roche beneath it; instead, we find a tumultuous bed of stones, without arrangement of any kind. There is no attempt at stratification, the large and the small stones are tumultuously thrown together, just as much so as if they had been simultaneously tipped out of some huge vessel, and so left; but surrounding each stone there is a matrix of clay marl, generally forming a compact matrix, but not necessarily uniformly so. The sections of quarries on the south and west sides are all similar, except that this deposit of stones varies in thickness from three or four feet to eighteen or twenty feet.

These south and west sections being sometimes widely separated, and all being similar in general features, it is only fair to assume that the intermediate spaces between the quarries would exhibit the same general character.

It is from this bed that the stones forming our dry stone walls have been derived for, perhaps, centuries, the stones as they work up to the surface being removed by the agriculturist from time to time.

(*To be continued.*)

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

Continued from page 80.

PLANTAGINACEÆ.

PLANTAGO.

P. major, *Linn. Way-bread. Greater Plantain.*

Native: In pastures, on roadsides, and waste places. Common. June to September. Area general.

P. media, *Linn. Hoary Plantain.*

Native: In pastures, fields, and by waysides, in marly and calcareous soils. Locally common. June to September.

I. Hampton-in-Arden; Knowle canal bank.

II. Honington! Tredington! Halford, *Newb.*; Moreton Morrell; Alveston heath; Kineton; Binton; Exhall; Oversley; Little Alne; Bearley; Lapworth Street; Brandon.

P. lanceolata, *Linn. Ribwort Plantain. Rib-grass.*

Native: In pastures, meadows, on waysides, &c. Common. May to September. Area general.

Var. *b. Timbali.*

Colonist or casual: In cultivated land. Very rare.

I. On the new embankment, Sutton Park, 1880-81.

II. As a weed in gardens about Myton, *H. B.*; Alveston Heath, 1880.

P. Coronopus, *Linn. Buck's-horn Plantain.*

Native: On heaths and heathy waysides. Rare. June to Sept.

I. Roadsides near Oscott College; Sutton Park; Middleton Heath; Coleshill Heath; near Bannersley Pool; Baddesley Heath; stone quarries, Hartshill; Bradnock's Marsh.
II. Kenilworth Heath, *Herb. Perry;* heathy footways near Brinklow.
[*P. arenaria.* P.S.—Occurs as a garden weed at Milverton, *H.B.* A native of Hungary.]

LITTORELLA.

L. lacustris, *Linn.* *Plantain Shore-weed.*
Native: In and about pools. Very rare. July, August.
I. Coleshill Pool! *Aylesford, B. G.*, 636; Olton Reservoir, abundant, 1881; Earl's Wood Reservoir.
[*Blitum capitulum, W.* Warwick Castle Park, *Herb. Perry.*]
[*Blitum virgatum, W.* Garden weed, Stratford-on-Avon, *Cheshire, Herb. Perry.*]
[*Amaranthus retroflexus, Linn,.* Near Stratford-on-Avon, *W. C.;* skin-yards, Kenilworth and Milverton, *H. B.*, *Herb. Perry.*]
[*A. Blitum, W.* New Town, Coventry, *Kirk, Herb. Perry.*]
[*A. deflexus.* Waste ground, Kenilworth, *J. B. Syme, Herb. Bab.*]
All these are mere casual weeds of uncertain occurrence.

CHENOPODIACEÆ.

CHENOPODIUM.

C. polyspermum, *Linn.* *Many-seeded Goosefoot.*
Colonist: In cultivated ground and corn fields. Rare. July to August, or later.
II. Alcester; Kinwarton; Oversley, *Purt.* iii., 24; Great Alne, *Herb. Perry;* Saltisford, near Warwick, *Per. Fl.;* as a garden weed at Myton; Whitnash; Milverton; Budbrook; Berkswell, *H.B.;* near Brown's Over Hall, *R. S. R.*, 1868; in cornfields, Ipsley! *Slatter;* Drayton, near Stratford-on-Avon.
All our plants are the variety *C. acutifolium.*

C. album, *Linn.* *White Goosefoot.*
Native: In cultivated ground and on roadsides. Common as an aggregate species. July to October.
a. candicans.
I. Railway banks, Sutton Park; Hartshill; Minworth, Temple Balsall.
II. Offchurch! Harbury; Tachbrook; Budbrook, *H.B.;* Stratford-on-Avon.
b. viride.
I. Railway banks, Sutton Park; Middleton; Coleshill; Maxtoke; Cornels End; Hampton-in-Arden.
II. Warwick, *Y. and B.;* Honington; Alveston Heath: Drayton; Berkswell; near Rugby.
c. paganum.
I. Railway banks, Sutton Park; Boldmir, near Sutton; Hartshill; Temple Balsall, &c.
II. Rare; in gardens and waste places about Milverton, Myton, Warwick, *H. B.;* cornfields, Berkswell, &c.
These plants have not been sufficiently discriminated to allow of a full account of their distribution.
[*C. murale, Linn.*, has been recorded in the new Botanist's Guide on the authority of the Rev. W. T. Bree. I have no knowledge of this as a Warwickshire plant.]

C. hybridum, *Linn.* *Hybrid Goosefoot.*

Alien: In cultivated land and on waste heaps. Very local. June to September.

II. Warwick, *W. G. Perry*, 1829, *Herb. Bab.;* on the road from Hampton-on-the-Hill to Warwick, *Perry, Fl.;* Alcester, in cultivated land! *W. C., Herb. Per.;* Leamington, *Y. and B.;* Emscote; Milverton! Myton! *H. B.;* near Oversley bridge; near the Avon in the Loxley road, Stratford-on-Avon; abundant.

[*C. urbicum, Linn.*, has occurred as a casual on railway banks, Sutton Park, and on waste places near Hoare Park, Over-Whitacre.]

C. rubrum, *Linn.*

Colonist: On waste heaps and in cultivated land. Rare. July to September.

I. Hampton-in-Arden, *R. Rogers.*

II. Brandon Lane, *T. K., Herb. Perry;* near the reservoir on the Radford road (near Coventry) *Kirk.;* Whitnash Brook; Myton, *Y. and B.;* common in the parish of Honington in dung yards! *F. Townsend;* on waste heaps near Milverton Station, Myton, Chesterton, *H. B.;* Lighthorne, *Bolton King;* Oversley; Drayton, near Stratford-on-Avon.

Var *b. pseudo-botryoides.*

II. Shrewley Pool, near Hatton, *H. B.*

C. Bonus-Henricus, *Linn.* *Allgood.* *Good King Henry.*

Denizen: Near church-yards, on waste places, and banks. Local. June to September.

I. Near Temple Balsall, *Herb. Perry;* Hampton-in-Arden; Knowle, by the church-yard; Marston Green; lane from Water-Orton to Minworth.

II. Kenilworth; Leek Wootton, *Herb. Perry;* Whitnash, *Y. and B.;* Tachbrook; Warwick; Milverton, *H. B.;* Salford Priors! *Rev. J. C.;* Barcheston, *Newb.;* Tile Hill; Princethorpe, Weston, near Coventry.

ATRIPLEX.

A. angustifolia, *Linn.* *Narrow-leaved Orache.*

Native: In cultivated land, on waysides, &c. Common. July to September. Area general.

A. erecta, *Huds.* *Erect Orache.*

Native: On waste heaps, banks, and in cultivated land. Common. July to September. Area general.

This includes the *A. erecta* (*Bab. Man.*) and the *A. erecta* (*E. B.*), between which I have not sufficiently discriminated to speak with confidence as to their distribution.

A. deltoidea, *Bab.* *Triangular-leaved Orache.*

Native or Colonist: On waste heaps and in cultivated land. Local or rare. August.

I. On waste heaps on the roadside between Ansley and Over Whitacre, abundant; Green lanes, Coleshill.

II. Myton, *Y. & B.*; Warwick; Leamington, *H. B.*; field at Drayton, near Stratford-on-Avon.

[*Chenopodium opulifolium.* Has occurred as a casual weed by road sides near Sutton Park, and on waste places near Milverton.]

POLYGONACEÆ.

RUMEX.

R. conglomeratus, *Murr.* *Sharp Dock.*

Native: By roadsides, waste heaps, banks, etc. Common. July to September. Area general.

Apparently very local in the district around Shipston-on-Stour.

R. nemorosus, *Schrad.* *Green-veined Dock.*

a. viridis.

Native: By roadsides, on waste heaps in woods, etc. Locally abundant.

I. Sutton Park; New Park, Middleton; lanes about Arley; lanes about Hampton-in-Arden, Solihull, and Olton, &c.

II. Honington; Tredington; *Newb.* Frequent near Warwick. *H. B.* Oversley; Combe Woods; near Rugby.

b. sanguineus. *Bloody-veined Dock.*

Denizen; in gardens and cultivated land. Rare.

I. Came up as a weed in my own garden, Aston, two or three seasons.

II. Near Leamington *Herb. Perry*; a garden weed, Warwick and Myton! *H. B.*

R. maritimus, *Linn.* *Golden Dock.*

Native: Near brackish pools and marshes. Very rare. May, June.

I. Near Perkin's Pool, Sutton Park. *J. P.*, *B. G.*

II. Chesterton Mill Pool; New Waters, Warwick Park; Wash Brook, Kenilworth, *H. B.* Fish Pond, Lighthorne; Chadshunt, *Bolton King.*

A mere casual in Sutton Park, in the other stations probably a native.

R. pulcher, *Linn.* *Fiddle Dock.*

Alien: In cultivated land, churchyards, and rarely on banks. Very rare. June, July.

II. Harbury Village, *Cross.* Chesterton churchyard and field adjoining! near Chesterton Wood. *H. B.*; Tredington churchyard; kitchen garden, Honington Hall; Stratford-on-Avon churchyard! *Newb.*

R. obtusifolius, *Auct.* *Broad-leaved Dock.*

Native: In woods, on banks, by roadsides and in fields and pastures. Common. June to August. Area general. The variety *a. Friesii* appears to be the prevailing plant of the county.

R. pratensis, *M. & K.* *Meadow Dock.*

Native: In fields, by roadsides and on banks. Local and rather rare. June to August.

I. Lanes about Solihull; Lanes about Hartshill.

II. Harborough Magna! *Rev. A. Blox;* lanes about Old Park, Warwick! Myton; Tachbrook; Beausale; Balsall Common! *H. B.*

R. crispus, *Linn.* *Curled Dock.*

Native: By roadsides; on waste heaps, banks and cultivated ground. Common. July, August. Area general.

Var. *trigranulatus.* Rare.

II.—Cornfield near Harbury station; Chesterton Mill Pool. *H. B.* A large form which Mr. Bromwich thinks is var. *sub-cordatus*; in marshy ground, Avon-side, Hill Wootton. I have not sufficiently discriminated between the forms and varieties of this dock to be able to give a proper idea of their distribution.

R. Hydrolapathum, *Huds.* *Great Water Dock.*
Native: In marshes, pools, canals, and rivers. Local. July, August.
I. Tamworth at the foot of Bowbridge on the Coventry Road, *With.*, ed. 7, ii., 455; meadows near Dosthill; canal near Atherstone; lane from Water Orton to Minworth.
II. Near Bidford! River Arrow, near Alcester! *Purt*; Hill Wootton; Myton; Warwick; Wasperton, *H. B.;* Salford Priors! *Rev. J.C.;* Binton Bridges; Oversley Mill; Bearley Canal; Tardebig Canal; Sowe waste canal; canals near Rugby.

R. Acetosa, *Linn.* *Common Sorrel.* *Green Sauce.*
Native: In woods, pastures, meadows, on banks and waste places. Very common. May to July. Area general.

R. Acetosella, *Linn.* *Sheep's Sorrel.*
Native: On heath lands, railway banks, sandy fields, etc. Common. May, June. Area general.

(*To be continued.*)

Natural History Notes.

SAPCOTE BORING.—Mr. Paul sends us a lengthy note on this subject, but as it is mainly personal and controversial, without adding a single new or unpublished fact, we do not feel justified in printing it.

BADGER.—On the 15th Feb., 1884, a fine female badger was met with and captured in the parish of Packington, Leicestershire, and is now in the care of the Earl of Loudoun. I cannot learn that a badger has been seen in the neighbourhood for the last forty or fifty years, until now, and consequently they were believed to be extinct. I am informed that this one was found whilst coursing in some fields. It was seen to come out of one hole and try to force itself into another, which it failed to do, and thus was easily secured from behind.—W. S. GRESLEY, Overseal, 19th Feb., 1884.

MEADS OF ASPHODEL.—"He prayeth best who loveth best all things both great and small," so that there is little need to wonder at Kingsley's love for beautiful blossoms. Writing from Biarritz in April, 1864, he says, "The hills here are covered with the true Cornish Heath, pale blue vernal Squills, a great white Potentilla (P. verna), and a long lilac flower, which seems to me a Borage or a Bugloss. There are the most lovely sweet-smelling purple Pinks on the rocks here, and the woods are full of Asphodels—great Lilies, four feet high, with white and purple flowers. I saw the wood yesterday where the dreadful fight was between the French and English, and over the place where all the brave men lay buried, grew one great flower bed of Asphodels. So they "slept in the meads of Asphodel," like the old Greek heroes in Homer. There were great "Lords and Ladies" (Arums) there growing in the bank, twice as big as ours, and not red, but white and primrose—most beautiful. You cannot think how beautiful the commons are; they are like flower gardens, golden with Furze, and white with Potentilla, and crimson with Daphne, and blue with the most wonderful blue flower (Lithospermum) which grows everywhere. —*Veronica*, from *The Garden.*

NITELLA MUCRONATA IN BEDS.—The statement by Mr. Hamson in the February "Midland Naturalist," with reference to the re-discovery of this plant, requires some qualification. It was first gathered by a youth named C. H. Davis. Specimens of this and some other Characeæ were sent me by Mr. Davis. When it was known, through the kindness of Messrs. Groves, that one of them was really *Nitella mucronata*, I at once arranged to visit the station, see it growing, and gather some for distribution. This was only possible by wading through about a foot of floodwater, beneath a drenching shower, the youth directing my steps to the spot, which had been recently submerged owing to the heavy rains with which the month of October, 1882, was characterized. Much time was spent during the summer of 1883 to find it in fruit, but unsuccessfully, and it is gratifying to know that it has recently been again found not far from its only known station in 1882. Of course, readers of the "Midland Naturalist" are aware that it had only once before been gathered in Britain by Mr. Borrer many years since.—J. SAUNDERS, Luton.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, February 26th.—Mr. T. H. Waller was elected as chairman of the section for the ensuing year. It was decided to defer the appointment of a secretary till next meeting. Mr. Bagnall exhibited *Philonotis calcarea*, *Philonotis cæspitosa*, *Bryum pallescens*, all new to Warwickshire; *Fissidens pusillus*, *Fissidens incurvus*, *Scolopendrium vulgare*. The last three are rare and were collected near Rugby. Mr. W. P. Marshall described three photographs of the Great Kimberley diamond mine, and exhibited an enlarged diagram constructed from them. Mr. J. Levick exhibited a large number of photographs of the diamond fields and various curiosities from South Africa. Mr. Austin made some remarks in continuation of the information he gave at a previous meeting. GENERAL MEETING, March 18th.—Mr. C. Pumphrey exhibited the palate of the shell fish *Haliotus tuberculatus*, which he had prepared from specimens collected in the Channel Islands. Mr. W. B. Grove, B.A., exhibited two micro-fungi, *Botryosporium pulchrum*, from Sutton; and *Stachylidium bicolor*, var. *cyclosporum*, from King's Heath, new to Britain. BIOLOGICAL SECTION, March 11th, Mr. W. R. Hughes in the chair.—Mr. T. Bolton exhibited *Clathrulina elegans*, new to Great Britain. Dr. M. C. Cooke then read a paper on "Dinners and Diners all the World over," in which the writer proposed taking a geographical survey of the principal articles of animal food, passing first to the polar regions of Europe, and the warmer countries of Southern Europe, thence to tropical and subtropical Asia, the Islands of the Pacific, and Australasia, ending the Old World with Africa. After which, he passed to the New World, United States, Central States, and the countries of South America, enumerating some of the curiosities of animal food to be met with during such a progress. This gastronomic tour was terminated by a return to England and a hasty summary of some of our own eccentricities of animal food, with a graphic picture of the animal food consumption of the metropolis. At the close of the paper, Mr. W. R. Hughes proposed a vote of thanks, which was seconded by Mr. J. Levick, supported by Professor Hillhouse, and passed unanimously. SOCIOLOGICAL SECTION.—The eleventh ordinary meeting of the section was held on Thursday, 20th March, in the Society's Room at Mason College. The President, W. R. Hughes, Esq., F.L.S., was unanimously requested to re-deliver before the Section the lecture on "The Synthetic Philosophy of Mr. Herbert Spencer," which he has recently given to the Handsworth Natural History and Scientific Society. The consideration of Mr. Spencer's "Principles of Biology" was then continued, Chapter 2 of Part II., on Development, being introduced by Mr. W. W. Collins. On Thursday, 27th March, at a special meeting, the index to Mr. Spencer's "Study of Sociology" was proceeded with, under the leadership of Mr. F. H. Collins.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 18th.—Mr. Flower showed egg of budgerigar. Mr. Madison the following shells: *Bythinia leachii*, from Weston-super-Mare; *B. tentaculata*, from the Birmingham district; and large specimens of *Valvata piscinalis*, from near Cheddar. The following objects were shown under the microscopes: Mr. Dunn, sugar mite (*Acarus sacchari*); Mr. Tylar, eggs of shrimp, showing development of embryo; Mr. Foster, spring plant bug (*Tingis hystricellus*), from Ceylon. February 25th.—Mr. Dunn exhibited several ammonites from Lyme Regis, some cut and polished, showing casts of the shell in iron pyrites; Mr. Tylar, cat's-eye-stone, *Crococodolithe*, in the rough, also polished; Mr. J. W. Neville, specimens of horned aphis (*Ceratuphis lataniæ*), an insect new to this country, having been introduced into English hot-houses on foreign orchids. Apterous females and young were shown, the perfect or winged form being as yet extremely rare; Mr. Foster, Challenger dredgings from Antarctic Ocean. Mr. Delicate then read a paper on "Some phases of mind common to man and the lower animals." The paper dealt with reason, instinct, and genius, defining them and showing their existence in various degrees. The paper was largely illustrated with anecdotes and diagrams. March 3rd.—Mr. Madison showed *Anodonta cygnea* and *A. anatina*, from Blackroot Pool, Sutton Park. The following objects were shown under the microscopes: Mr. J. W. Neville, a trough of *Cyclops quadricornis* all infested with epistylis taken from a pool where they abound in this state. Mr. Tylar, crystals of menthol by polarised light. March 10th.—Mr. F. Shrive, a house sparrow (stuffed) with curiously misshapen upper bill; Mr. Madison, *Planorbis corneus*, from Hall Green, a large variety from Stensall Common, York, and *P. corneus* var. *albida*, from Minster, Kent; Mr. Tylar showed under the microscope viscid lines of spider's web; Mr. Moore, gizzard of *Locusta viridis;* Mr. J. W. Neville, a wing of foreign butterfly, *Orthoptera rhadamanthus*. Mr. Dunn then read a paper. "Notes on the Naiads." The paper described their place in the animal kingdom, and compared them with the familiar earthworm. Of the several species two, the free-swimming and mud-boring, were taken as types of the whole class; their food and manner of feeding, their anatomy, mode of breathing, nervous system, peculiar circulation, natural economy, parasite, locomotion, reproduction, etc., were fully described. The paper was illustrated with a living specimen and diagrams.

CARADOC FIELD CLUB.—The Annual General Meeting of the club was held at the George Hotel, Shrewsbury, March 14th, the Rev. J. D. La Touche, President, in the chair. The Field Meetings fixed for the forthcoming season are as follows:—May 20th. Lebotwood for Roman Road, Devil's Causeway, and Plaish; June 13th. Ludlow for Bone Will and Richard's Castle; July 29th to 31st. Tewkesbury; Sept. 26th. Bomere, Betton and Berrington Pools. According to the usage of the society, the last of these excursions will be devoted to the collection and study of cryptogamic plants. The Rev. W. Elliot and the Rev. Canon Butler were elected honorary members; the Rev. C. Warner and Mr. W. E. Beckwith, Vice-Presidents; and Mr. W. Phillips, F.L.S., was appointed sub-editor for the society, for the "Midland Naturalist." Mr. R. H. Law, having tendered his resignation as Secretary and Treasurer, in consequence of leaving the neighbourhood, was thanked in complimentary terms for his valuable services by the President on behalf of the members, and the Rev. T. Auden, Vicar of St. Julians, Shrewsbury, was unanimously elected in his place.

HANDSWORTH NATURAL HISTORY AND SCIENTIFIC SOCIETY.—This Society was started in 1881 with the object of mutual help in obtaining scientific knowledge. Popular lectures on subjects from all sciences and Natural History are provided during the winter, and excursions in the summer. The members number at present sixty-six. Visitors are admitted at all meetings. The President is Mr. G. Sherriff Tye; the Secretary, Dr. William L. Hiepe, 68, Villa Road, Handsworth. The meetings are held on alternate Tuesdays at Portland House, Soho Hill, at 8 p.m. The seventh general meeting was held on Tuesday, February 19th, at 8 p.m., at Portland House, Soho Hill. The chair was occupied by the President, Mr. G. Sherriff Tye, and there was a good meeting. Mr. William Madeley, Hon. Secretary of the Dudley Geological Society, delivered a lecture on "The Life of the Coal Period." The audience followed the lecturer with great interest and attention, and some time was occupied after the lecture by the inspection of the numerous and splendid specimens of fossil ferns, Sigillaria, Lepidodendron, scales of fish, etc. The eighth general meeting was held on Tuesday, March 4th, the chair being occupied by Mr. F. A. Walton. The lecturer of the evening was Mr. E. Mundye, Head Master of the Birchfield High School. The subject was "The Phenomena of Light and Colour." The lecturer explained the vibration theory of light, in opposition to the older emanation theory, and then he showed the phenomena of reflection, refraction, dispersion, phosphorescence, etc., with the aid of a magnificent oxy-hydrogen lamp kindly lent by Mr. H. Lane. All the experiments were successful and striking, and although the lecture occupied above an hour and a half, the audience, which consisted of over eighty, followed it with great interest to the end.

NOTTINGHAM NATURALISTS' SOCIETY.—February 19th. Mr. J. Shipman read an interesting paper entitled "The Story of the Hemlock Stone," in which he took an entirely new view of the origin of this most curious pillar of rock. At the conclusion of the paper, which was of considerable length, Professor Blake, M.A., F.G.S., Mr. E. Wilson, F.G.S., and others took part in the discussion, and warmly combated some of the theories put forward by the essayist; it was also decided that the subject should at some future date be again brought forward for further discussion. March 4th.—Mr. E. Francis, F.C.S., read a paper on "The Chemistry of Chalk," in which he first referred to the formation of the soluble acid carbonate of lime, which, being carried in solution by streams and rivers to the ocean, is used by the foraminifera in building up their shells, which are composed of carbonate of lime. He then passed on to the microscopic character of the chalk, which was shown to be almost entirely made up of foraminifera and the siliceous portions of diatoms. The paper was profusely illustrated by diagrams and chemical experiments. March 6th.—The annual soirée and exhibition was held in the large hall of the Mechanics' Institution. The programme included a great variety of objects of science, art, local manufactures, &c. Microscopes were exhibited by a number of gentlemen during the evening. Perhaps the most novel part of the exhibition was the naturalists' dinner table, which was presided over by the Hon. Sec., Mr. B. S. Dodd, and on which was served up a number of dishes not commonly partaken of; the mênu consisting of rat-pie, stewed squirrel, roast hedgehog, fricassée of frogs, French snails, horse steaks, reindeer tongue, seaweed jelly and blancmange, American pop-corn, and a number of vegetarian dishes. The Hon. Sec. was ably assisted in this department by Mrs. W. Foster, Jun., and Mr. H. Foster. An organ recital was given during the evening by Mr. W. G. Taylor. March 18th.—Dr. Handford read a paper on "The Circulating Fluids in Plants and Animals." The paper was of considerable interest, and entered very minutely into the subject. Commencing with the lowest types of plants and animals, the lecturer reviewed the simplest forms of circulation; and then proceeded to deal with the blood of the vertebrate animals, referring to the various shapes and sizes of the blood corpuscles in different animals. In conclusion he drew attention to the "fugitive corpuscles," recently discovered by Dr. Norris in the blood of mammalian animals, and which were only to be detected by careful preparation, not from their small size, for they are as large as the ordinary red corpuscles, but that they are rendered invisible owing to their having the same refractive index and the same colour as the *liquor sanguinis* in which they are submerged. These "fugitive corpuscles" are considered by Dr. Norris to be the source from which the red corpuscles are developed, for, when brought into view and carefully examined, they are found to be colourless bi-concave discs, and between these and the red bi-concave discs the existence of other bi-concave discs, possessing every gradation of tint, could be detected not only by the eye but more conclusively by the aid of the most delicate photo-chemical tests. The paper was illustrated by numerous diagrams and drawings and also by microscopic slides.

TAMWORTH NATURAL HISTORY, GEOLOGICAL, AND ANTIQUARIAN SOCIETY.—On February 25th a paper was read by Mr. F. A. Grayston on "The Solar System." The lecturer dealt with the nebular theory—the sun, earth, and moon—showing its three stages of development. In the case of the moon the lecturer suggested that the volcanoes, which are of a larger size than those of our own planet, might be so owing partly to the more rapid cooling of that body in consequence of its smaller size. On the debatable question as to whether Jupiter and Saturn are self-luminous bodies, he was inclined to think that the later theory (that they are) was not satisfactorily proved. Lantern slides were given in illustration.—On March 10th "Town Charters" was given by the Rev. T. Forster Rolfe. Starting from the point of the Tamworth earliest Charter (1317), he illustrated it by the early history of the Saxon Monks, the customs of various places from Domesday Book, and the Charters of London, Lincoln, Beverley, and Oxford, to the time of Edward III.

Plate III.

Fig 1. $\frac{650}{1}$

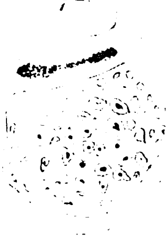


Fig. 2. $\frac{650}{1}$

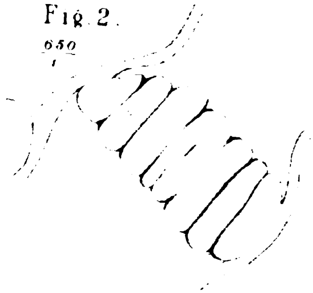


Fig 3. $\frac{650}{1}$

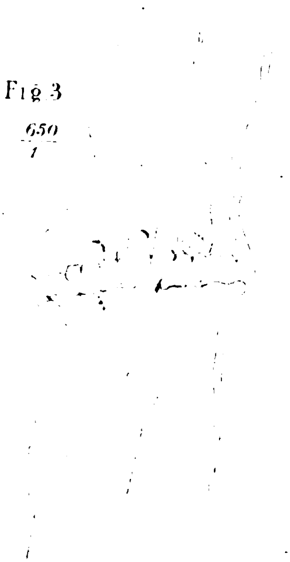


Fig 4. $\frac{650}{1}$

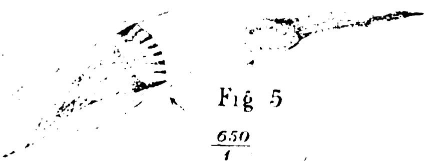


Fig 5. $\frac{650}{1}$

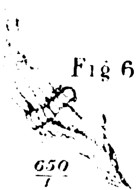


Fig 6. $\frac{650}{1}$

W Hillhouse, ad nat. del.

Herald Press Lith.

INTERCELLULAR RELATIONS OF PROTOPLASTS

ON THE INTERCELLULAR RELATIONS OF PROTOPLASTS.—III.*

BY WILLIAM HILLHOUSE, B.A., F.L.S.,

PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY AT THE MASON SCIENCE COLLEGE, BIRMINGHAM.

(*Continued from page 105.*)

The method of development of the sieve plate and its perforations affords still disputed ground in several particulars. The partition wall is at first single and homogeneous, but, according to Russow, prior to the appearance of the callus is already punctate in that portion of its membrane where the sieve area will be formed, while Wilhelm and Janczewski maintain that the punctation does not appear till after the callus formation. Very early the area is covered on both sides

PLATE III.

DESCRIPTION OF THE FIGURES.

FIG. 1.—Terminal sieve plate of *Bryonia dioica*, in transverse section of stem.

FIG. 2.—Terminal sieve plate of *Bryonia dioica*, in radial longitudinal section of stem, very greatly swollen with Russow's Aniline Blue, but showing strongly-marked sieve canals. The remains of the original sieve plate wall are still visible, though very indistinctly, not quite so clearly as in the figure.

FIG. 3.—Terminal sieve plate of *Bryonia dioica*, in longitudinal radial section of stem, also treated with Aniline Blue, but much less swollen that that in Fig. 2. Protoplasmic threads, few in number, can be seen passing to and through the plate.

FIGS. 1 – 3 were drawn from sections taken from alcohol material gathered in August.

FIG. 4.—Terminal sieve plate of *Cucurbita Pepo*, in longitudinal radial section of stem, showing the mucous collection on each, but mostly on one side of the sieve plate, traversed by strands which also pass through the sieve perforations. Taken from alcohol material of July, 1881, the section having been now two years mounted in glycerine, stained Logwood. The protoplasmic mucous is of a dirty pale-brown colour, and the threads show more plainly than depicted in the figure.

FIG. 5.—Sieve plates of *Cytisus Laburnum* in longitudinal tangential sections of stem, after 24 hours in Potassium Iodide Iodine, and previous treatment with Chlorzinc Iodine. December.

FIG. 6.—Sieve perforation in *Cytisus Laburnum*, after staining with Alcohol Iodine and removal of the walls by 48 hours in strong Sulphuric Acid. July.

* Transactions of the Birmingham Natural History and Microscopical Society. Read March 18th, 1884.

with small but gradually enlarging callus projections, exactly harmonising in position on the two sides, which projections indicate the position of the future perforations. According to Russow, these callus formations are first made in the pre-existing depressions in the wall, while Janczewski* and Wilhelm believe that these local thinnesses show only after the projections have developed to a certain extent. All three observers agree, however, that at this period the original cellulose membrane is no longer simple and plain, but is now composed of a network of thicker parts, with a meshwork of thinner, the thinner parts lying between the corresponding projections in question, the network representing the parts free from these projections. As to the source of the callus, there is another divergence of opinion. Wilhelm says, somewhat hesitatingly, that it arises from a local transformation of the cellulose; Janczewski affirms this with positiveness; Russow, on the other hand, claims that it is in no way the result of cellulose transformation, but is in all cases a new deposit from the protoplasm of the sieve tubes. Quantitatively it appears improbable that the thick callus which many sieve tubes possess should be entirely a transformation of the original extremely thin cell wall; equally improbable does it seem to be that the protoplasm should form new cellulose deposits only to have them at once reconverted into callus. Such cellulose deposits would have to be either internal or external, but of these there is never the slightest sign.† The deposit of callus can go on slowly for considerable periods; Russow thinks that the amount deposited is dependent on the length of period during which the sieve perforations remain open, and the sieve tube thus active. But, on the other hand, it is quite clear that in Monocotyledons, where the sieve tubes remain active for the greatest length of time, there is a smaller formation of callus than in Dicotyledons, where the sieve tube is seldom active for more than two or three years.

* Janczewski in his earlier observations held the same opinion as Russow, viz., that the wall was pitted before the formation of the callus.

† As callus is but a modified form of cellulose it is more probable that both processes go on, the original callus formation, so far as it involves the thinning out and local disappearance of the original cell wall, being due to transformation, subsequent increase being due to callus deposit. Transformation, however, if it takes place, is apparently not simple. Many of the reactions of callus are distinctly semi-protoplasmic. Some suggest a resemblance, probably however merely casual, to the basis substance of the cell-nucleus—nuclein (a name first given to it by Hanstein, although Miescher and Hertwig had both previously employed the term, and equivalent to the chromatin of Flemming, and Kernsubstanz of Strasburger).

Thus Russow himself mentions the case of *Yucca aloifolia*, 15 years old, where the sieve tubes in all the fibro-vasal bundles were still active and had callus coverings to their sieve plates, the callus, nevertheless, being no thicker in the oldest than in the youngest tubes; while, on the contrary, in many herbaceous Dicotyledons of exceedingly rapid growth (*Bryonia*), the callus formation is often very considerable.

To resume our account of the sieve development. The callus projections now swell, fuse together, and completely cover all the parts of the young sieve plate; and in those places where previously the cellulose wall was thinned (called above the "meshwork") this wall now entirely disappears, having been either dissolved or transformed into callus, so that at these points the callus on the two sides of the plate is fused. The young sieve is now ready for perforation. In the meantime great changes have taken place in the contents of the tube, which it is not a part of our present purpose to describe, and masses of protoplasmic jelly have accumulated on either side of the still closed sieve plate, separated from it by the parietal layer of protoplasm. Opposite to some or all of the meshes of the callus this jelly puts out a minute prolongation, covered by the parietal layer, which gradually penetrates the callus substance of the sieve, perforates it, and fuses with the similar mucous substance of the cell on the other side of the plate, forming thus a continuous filament. Up to this time the sieve tube has been in what Janczewski calls an "evolutive" state; it now passes into what he calls the "active" state, in which it will remain for a varying period (see Plate III., figs. 2 to 5). A sieve plate thus formed consists therefore of a very delicate network of cellulose, shown still faintly in Plate III., fig. 2, taken from *Bryonia dioica*, covered by a callous envelope, which lines also the perforating canals. If in this state the cell-wall, &c., be entirely removed by sulphuric acid the connecting threads will perhaps be left intact, communicating from one cell to the other through the thickness of the sieve, as is shown in Plate III., fig. 6 (*Cytisus Laburnum*).

Such is the typical method of development of the sieve perforations and plate in Angiospermous Phanerogams. In the references to the literature above, I have noted that a certain amount of relation appears to exist between the viability of the sieve plate and the seasons. My own investigations upon the roots of hardy dicotyledonous trees, both deciduous and evergreen (*e.g.*, *Cerasus Laurocerasus*, *Rhododendron ponticum*, *Cytisus Laburnum*, various species of *Acer*, *Quercus*, *Æsculus*, and those of *Cheiranthus Cheiri*), lead me to agree with Russow that in roots the sieve pores are not closed in winter. As the two winters during which I have from time to time investigated this point, viz., 1882-3 and 1883-4, have been remarkable for their mildness, I cannot venture to say what might be the case in seasons when the cold is intense; nor have I examined any half-hardy plants to see whether their behaviour is different. In the case of stems the closure in winter has not been nearly so complete as previous statements would lead to believe. Here again, however, the extreme mildness of the two seasons may have had some effect. The general view of Janczewski is that the function of the callus is to close the sieve pores in winter. Russow has, however, pointed out the frequency with which in winter the callus shows differentiation, in the form of striæ passing from cell to cell. These striæ are probably mucilaginous filaments of protoplasmic material; the swelling callus has closed upon them, but has not shut them out. The perforations are, therefore, probably not completely closed.

When open the sieve pores are lined by a callus layer, which continues into the main callus deposits on either side of the sieve plate. When the pores are closed in winter the closure operates by means of the swelling of the callus in autumn. Once closed the pores remain so through the winter. In spring the callus in each pore contracts and the pore again becomes visible. This reopening can be produced artificially, *e.g.*, by passing a branch of a vine for a week or so into a warm moist chamber. The actual data of the reopening no doubt varies from year to year, as well as from plant to plant. On January 20th, 1883, after about three weeks of very open weather, I found (at Bonn) the sieve tubes of *Syringa vulgaris* (the Lilac) fully open.

The relations of the constituent elements of the sieve tubes in different great groups of plants afford a field of evolutionary speculation. In all the investigated Vascular Cryptogams the sieve tubes are present, but they are always closed—never communicate by pores. The membranes forming their end walls are pitted, but are usually unprovided with callus. In *Pteris aquilina* (the Bracken Fern), which one would not naturally suspect of a high degree of development, the walls are perforate at the pits, but the perforations are completely closed by the callus formation; so that here the sieve tubes appear to show the initial stage of a higher development.

In Gymnosperms, on the other hand, the sieve plates, both terminal and radial, are callous when young, prior to the opening of the sieve pores; later the callus is entirely dissolved, leaving the pores open and the sieve plate quite bare. But at the same time, however, the protoplasm disappears from the sieve tubes, leaving behind only a watery fluid.* On passing from their evolutive stage, the sieve tubes of conifers pass directly into a passive state. Another point of biological interest is that in conifers each sieve element is directly formed from a cambial cell, without undergoing, as in Angiosperms, any prior subdivisions.

A final point of interest is the contents of the tubes in the different groups of plants. In Vascular Cryptogams the sieve tubes contain neither protoplasm (other than a very thin parietal layer), nor nucleus, nor starch; the parietal layer of protoplasm contains, or has adherent to it, a number of highly refractive globules of albuminous nature, which especially accumulate at the base of the pits. These globules are often much more numerous on one side of the sieve plate than the other.

In Gymnosperms, as the sieve tube approaches its complete state, the nucleus first disappears, then the bulk of the protoplasm, while a thin parietal layer of this persists till the time when the pores are opened; this parietal layer contains a number of highly refractive granules, of albuminous nature, especially abundant near the sieve plates; starch is absent.

In Monocotyledons, as the sieve tube approaches its complete state, the nucleus first disappears, then (or, *e.g.*, in *Phragmites* previously) the protoplasm is reduced to a thin parietal layer, with sometimes (*Typha*, *Phragmites* †) a mass of very refractive protoplasmic jelly collected on both sides of the sieve plate, but more largely on one side than on the other. In other cases (according to Russow generally) this jelly mass is not present; numerous refractive granules, albuminous in nature, adhere to the parietal protoplasm, chiefly near the sieve plates. Starch is rarely present.

In Dicotyledons, as the sieve tube approaches its complete state, the nucleus first disappears, then the protoplasm is reduced to a thin parietal layer, a mass of albuminous jelly is collected chiefly at one side of the sieve plate (well shown in Plate III., fig. 4), and a similar mucilaginous strand often traverses the length of the constituent cell. Starch is very generally present during the active life of the tubes, and, as I have demonstrated in a very large number of plants, mainly on one side of the plate.

* This, however, I have seen show a clear proteid reaction.

† Janczewski, l. c.

It will be seen, therefore, that in all cases the nucleus has disappeared from the mature sieve tube, the protoplasm has diminished to a parietal layer of small thickness, while in Cryptogams, Gymnosperms, and some Monocotyledons there has been a variable development of highly refractive globules of albuminous nature, and in Dicotyledons and other Monocotyledons there has been a similar variable development of an albuminous or proteid mucous or gelatinous substance. Is the mucous of Dicotyledons equivalent to the jelly of Monocotyledons? Have they any genetic relationship with the albumincus refractive globules of the Cryptogams and Gymnosperms?

(*To be continued.*)

THE BASALT OF ROWLEY REGIS.

II.—THE ROCHE AND CLAY-MARL.

BY C. BEALE, C.E.

(*Continued from page 112.*)

The roche is a peculiar development of the basalt, and it is the facts in connection with this material which we have now to review. I have just said it is a mass of dry rocky material, which breaks up into small cubical morsels in the hand without any difficulty; that is, doubtless, one great feature in the roche, but it is only one feature.

The roche is of various depths, but, perhaps, if we give it an average of twenty or twenty-five feet we shall not be overstating the fact. It occurs in various forms. We find it in one place in thin vertical bands of from three to fifteen inches in thickness; these bands are not solid throughout, but consist of a number of plates about an eighth to one quarter-of-an-inch in thickness; removing these we find they crumble as already described.

These vertical bands occur as partings between a different development of the roche, consisting of spheroidal masses formed of concentric layers of the same thickness, generally, as the vertical plates, each mass having for a nucleus a compact fine-grained spherical mass of true basalt, but of a somewhat darker colour than the stone below, and very much harder. These spheroidal masses are roughly arranged in columnar fashion, and are of various dimensions, not only as regards the columns, but also as regards each individual mass. The columns are sometimes but a few inches in diameter, sometimes as much as five or six feet; and it is noticeable that the columns do not uniformly consist of masses of equal diameter. We should find, taking any column at random, that there were, perhaps, three or four or even a greater number of similar sized masses; then would come a division of the mass into two or more nuclei, and again a further subdivision into a very large number of nuclei within the original diameter of the column, and again we should come to single masses occupying the whole width of the column.

These varying masses of roche are not continuous over the extent of any quarry now open, but occasionally—between—occur masses of the basalt itself, leading on to the solid stone below. A face of the quarry showing these columnar masses of nodular roche is a beautiful and interesting sight to the geologist, though eminently unsatisfactory to the quarry owner. Sometimes the concentric layers weather off in places, so that many thicknesses of the covering of the nucleus are exposed, and the effect of light and shadow resulting therefrom is often striking as well as beautiful.

The whole of this mass of roche must be removed before the quarry can be worked satisfactorily.

It has been held, I believe, that this mass of roche was once solid basalt, thrown up from below, and of similar quality and hardness to the true stone upon which it rests, and that its present state is the result of decomposition due to atmospheric or other influences; but I can see nothing to bear out this theory. On the contrary, I believe there is abundant evidence to show that we find the roche exactly as it was to be found when it cooled after its eruption, consisting of exactly the same component parts as when erupted, and that the rude columnar structure in the roche, as the more perfect columnar structure in the true basalt, is due to the cooling of the different masses.

When we see a mass of true basalt occurring here and there, side by side with masses of roche; when we consider that each has been subjected to the same influences, that what has touched or affected one mass has equally touched and affected all; and when we consider the diverseness of the materials as they stand now, we cannot come to any other conclusion than that both masses are practically *now* the same as when thrown out from Nature's laboratory. We might, if further proof were necessary, find it all over the hills themselves; proof that the true basalt *does not weather*—remains unchanged under all circumstances of atmospheric or sub-aerial influences. Take an instance. The native blocks already referred to are what we might call weathered—that is, the colour is altered from its original blue to a warm buff, partly perhaps by the decomposition of the felspar contained in the exterior parts liable to be acted upon, but much more so by being stained by ferruginous or other matters in the moist materials in contact with them. And so it is with the true stone in the quarry; wherever you see a joint—no matter whether it is stone against stone or stone against a roche parting—then you see the uniform rich buff colour. In both instances the discolouration extends to about a similar depth. Now it would not be *quite* safe, I suppose, to argue from this that the exterior colouring of both blocks and rocks dates from the same period; and yet I am inclined to think that such is the case, because when I search my favourite old walls—the very oldest of them—or even when I examine some of the many huge blocks which, from their ponderous size, have been allowed to remain where placed by Nature countless ages ago, what do I find? I find that when any stone or block has been fractured, subsequent of course to its fracture of detachment from the solid rock, no discoloration, no weathering, has taken place; that, instead of the buff colour of blocks and joints in quarry, the fractures show a black face, and therefore that no weathering has taken place during the centuries or milleniums in which they have been exposed; and I deduce from this that practically true basalt does not weather or decay, and that the roche is an entirely different substance of basaltic origin, but wanting in some of the component parts of true basalt, and that we find it in its original condition.

I have said that directly we turn the southern shoulder of the hill we have no roche beneath the surface soil; the same may be said of the extreme tops of the various bosses of the range of these Rowley Hills, but the circumstances of these two cases are widely different. On the tops of the hills the roche has been removed, degraded. That it had covered these parts could, I think, be easily shown, even leaving analogy out of consideration; but as we turn southwards we find the roche *in situ* and persistent over the whole south and west area, only it is here covered by our bed of native blocks already referred to. We find, then, a general section of the hills would give—

Basalt at base,
Roche above, covered by
Surface soil;

but at the apex we have a section of basalt only, the surface soil, only three to nine inches, being hardly worth notice; while on south and west our section would be—

Basalt at base,
Roche above, obscured by till or bed of
Native blocks, and covered by
Surface soil as before;

thus accounting for the waste or degradation of the hill tops, and pointing out the direction from which the degrading forces proceeded.

I think in the above we have another proof of the roche being in its original condition, for we find it of precisely the same structure, and arranged similarly to where it has no protecting covering of till. Where it is not so covered (on the north and east) the beds are no thinner, *i.e.*, disintegration (?) has not proceeded more rapidly or done more work than on the south and west where it is thickly covered, well protected, and the material itself is not any more friable, more decomposed, or "rotten," than where such covering protection obtains.

We now come to consider the clay-marl, and this subject opens a much wider field than that we have just been discussing.

The clay-marl covers a very considerable area on either side the centre line of eruption, and as it is abundantly evident that it results from the degradation of the roche, and from this cause solely, we should expect to find it thinnest a little below the shoulders of the hill, thickening as we descend to the valley bottoms, and again thinning out to nothing as we approach the outer margin of the deposit; and as a matter of fact this is really what is found.

This high land must have been considerably higher at the close of the eruptions: first, by reason of the great thickness of roche overlying the present tops, and, secondly, by reason of the much greater depth of the surrounding valleys, subsequently filled with the degraded roche.

The outer margin of the clay-marl area we may take generally as being about one-and-a-half miles on either side of the axis of eruption, and this axis lies as near as possible due north and south. The outer margin of the deposit is obscured for the most part by two series of drift-clays and gravels; the earlier being the ordinary boulder-clay of the district, including gravels and boulders derived from the Bunter conglomerate, and the later (gravel and clay) is a local re-wash of the surface deposits and outcrops of local rocks and measures existing at the period of a later deluge. There is evidence high up on the hill sides that one of these series—I am inclined to think the earlier one—once enveloped the hills, detached patches of gravel, clay and boulders, occurring nearly as high as Rowley village, thus informing us of greater and more varied changes having occurred than we should otherwise be prepared to expect, and showing, I think, that we have not had any deposition of the missing strata between the upper coal measures and the boulder-clay, unless, indeed, the whole had been deposited and subsequently denuded. But in this case, I imagine, some little evidence would be left whereby we should be enabled to read aright the history of the deposition and removal of such strata, in the locality, just as we have the isolated patches of clays and gravels which remain to tell of the covering of these materials once in existence here.

If we make the circuit of the hills within the margin of the clay-marl deposit we find a series of deep marl holes, in none of which, that I am aware of, has the base of the marl been touched. The greatest depth reached has been about one hundred or one hundred and twenty feet, the bottom at this depth being equally good marl with that higher up.

These deep marl holes furnish evidence that the deposit did not take place continuously, for at a depth from the surface of about fifty feet we find a bed of fine conglomerate rock, the component parts of which are all of basaltic origin, unless we except the calcareous material cementing the mass. A section of the clay-marl in one of these holes would show thus:—

Clay-marl at bottom,	about	50	feet thick.
Basaltic conglomerate	,,	3 to 6	,,
Clay-marl band	,,	1 to 2	,,
Basaltic conglomerate	,,	2 to 5	,,
Clay-marl (upper)	,,	30 to 50	,,
Surface deposits	,,	2	,,

From this section it would appear as though the deposit had been arrested more than once, allowing for a considerable period to elapse wherein the materials composing the beds of conglomerate would have time to be collected and become cemented together. That there must have been a shore these materials abundantly prove, for they are all rounded pebbles, apparently.

There is one remark about this conglomerate which may be made here. The pebbles may not be pebbles—that is, stones rounded by aqueous action—at all; they *may* be the small nuclei of dark blue fine-grained stone abounding throughout the bulk of the roche *in situ*, liberated by the saturation and disintegration of the roche, consequent on its removal from the upper parts of the hills to the valleys, and on its reduction from roche to mud. But if the items of the conglomerate are nuclei, why do we not find them throughout the bulk of the marl, which is free from stones, either rounded or angular? We might say they have been washed out and collected by wave action, so as to form a beach or shallow bottom. That is possible, certainly; but then in that case why should they have collected in the position in which we find them? I must say that the little stones do *not* look like ordinary gravel, and though granting the possibility of their being nuclei, yet I incline to think they are pebbles; they are peculiar in whatever light we view them.

I have been told, when conversing with the owners, that fossils (molluscs) have occasionally been found in this clay-marl on the east side of the hills; but I have never seen nor have I found any myself, though I have often spent an hour or two in the pits with this object in view.

We see, then, that this clay-marl, which is used in the manufacture of our world-famous Staffordshire blue bricks, is a most interesting deposit, and unfolds a wonderful history—a history of fire and water, of tumult and repose.

(*To be continued.*)

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.*

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PART I.—INTRODUCTION.

Imagine an oval translucent vase of exquisite outline, carved from a single diamond, not indeed of the finest water, but brought from South African fields, tinged with a delicate yellow colour. Place beneath this a gracefully-curving slender stem, of crystal clear, and where they join let a circlet of the purest gold lie coiled within the tube. Then let a beautiful and limpid light radiate from every part. To enhance its effect, take a piece of the blackest jet, shaped into a perfect hemisphere. Polish its surface till it shines like a Venetian mirror, and gently poise this sooty crown over the mouth of

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the transparent vase. Let glistening strings of orient pearls hang round in graceful festoons, and imagine the whole of this priceless work reduced in size till the total height exceeds not a twentieth of an inch. To complete the contrast, thickly strew these fairy jewels on the half-dried surface of a cake of cow dung, and you have imitated nature as far as your powers allow. To mortals this treasure is known by the name of Pilobolus, and the particular species which I have pictured is called *Pilobolus Kleinii*. In order to see these tiny gems in all their beauty, the fungus must be viewed while in good condition, with a 1in. objective and abundance of light.

Of the genus Pilobolus there are recorded in the Handbook of British Fungi two species only, *P. crystallinus* and *P. roridus*, and no additions have been made, so far as I am aware, to this list of British species. The number of species now described as occurring in Europe is seven, besides two placed in an allied genus, Pilaira, one of which was formerly considered a Pilobolus. Thus, out of nine species, seven were unknown in Britain; of these seven the present paper records three which I have found in this neighbourhood, as well as one species hitherto undescribed which will appear in the sequel.

When the second edition of the Handbook is published it will differ from the first, if it reflects the present state of mycological knowledge, not only in containing an enormous number of new species, but in presenting a radical change in the main classification of the groups. To revert for a moment to the two instances which I have already brought before the notice of this Society—in the first place, the Myxomycetes will be far removed from the Gastromycetes, amongst which they are there stationed, being in fact relegated to almost the lowest position in the fungal scale, while the Gastromycetes will continue in their present position as a group closely allied to the Hymenomycetes. Again, the Pucciniacei and their allies (which form the Uredineæ and Ustilagineæ) will be widely separated from those species with which they are at present classed in the Coniomycetes, while the Torulacei will be absorbed in the Hyphomycetes, into which, as I hope to show on a future occasion, they graduate insensibly. The Sphæronemei and Melanconiei alone will remain, and, although the name Coniomycetes may be properly retained for them, yet it will have lost so great a part of the meaning which it has hitherto borne that in all probability it will be allowed to lapse into oblivion.

I have now to bring before your notice another instance of a similar character. The English system, true to its artificial nature, classes the Mucorini near to the Ascomycetes, that is, to the Pezizæ and Sphæriæ, with which they have nothing in common, but the fact that their ordinary spores are produced by the endogenous subdivision of the contents of certain cells, called sporangia in the one and asci in the others. But with the exception of this one solitary point of similarity, the Mucorini are wholly different from the Ascomycetes; they are really of a very low grade of organisation, and must be placed not far from the Myxomycetes themselves. Their nearest allies are to be found in the genera Cystopus and Peronospora, which by the same system are classified among the Coniomycetes and the Hyphomycetes respectively, and in other genera not included in the Handbook.

Part II.—MORPHOLOGY AND PHYSIOLOGY.

§ 1.—The Mucorini.

The Mucorini are characterised especially by their mycelium, at first unicellular, that is, not divided by transverse septa, however much it may be branched; septa are, however, afterwards produced at certain places for the purpose of restricting and directing the movements of the protoplasm. Branches of this mycelium are directed upwards, and bear usually globose or subglobose (in one group, cylindrical) sporangia, containing endospores. Sometimes in the course of the mycelium itself, or on short lateral branches, local accumulations of the protoplasm surround themselves by a firm membrane, and constitute a multiplicative apparatus, under the name of chlamydospores. Other branches of the mycelium end in cells, which are cut off by septa, and unite in pairs: the product of this union is called a zygote (formerly a zygospore), and corresponds to the fertilised ovule among the Phanerogams. The conjugating cells may or may not present appreciable sexual differences. The protoplasm which traverses the mycelium also offers certain characters by which by which it is essentially distinguished from that of other Fungi.

The Mucorini may be divided into four main groups:—

Sporangia more or less spherical and solitary.	Sporangial membrane heterogeneous, that is, consisting of a superior persistent cuticularised cap, and an inferior diffluent zone		Pilobolidæ.
	Sporangial membrane homogeneous, either entirely diffluent or entirely persistent; the extreme lower portion is, however, sometimes more persistent than the rest	Columella present usually very conspicuous	Mucoridæ.
		Columella wanting	Mortierellidæ.
Sporangia cylindrical and grouped in heads			Syncephalidæ.

Our attention will now be confined to the Pilobolidæ, the group which is highest in organisation and which contains the most remarkable and interesting species. Several of these are so easily obtained and form such pretty objects for microscopical display that it is strange they are not more frequently used for that purpose. It suffices to put a small piece of horse or cow dung beneath a bell-glass or inverted tumbler, preferably on a little damped Sphagnum or other moss; in a few days it will probably produce a crop of Pilobolus and may continue to do so for several weeks together. It is true that some students of nature may recoil from the unsavoury habitats in which Pilobolus usually, but not invariably delights, but as one of the monographers of the genus observes "La science ennoblit tout."

§ 2.—The Pilobolidæ.

The Pilobolidæ are distinguished by the heterogeneous membrane of the sporangium, that is to say, by the fact that it consists of two portions of very different characters. The upper portion (Fig. 8*a*) becomes thicker and tougher as the sporange approaches maturity, and at last almost absolutely black. But a narrow zone (Fig. 8*b*) near the point of junction with the stem, distinguished from the rest by its transparency and want of colour, is diffluent, that is to say, in the presence of water it becomes disintegrated or broken up into a number of minute granules, which pass away. This may take place without the removal of the upper portion of the sporangium from its position. The spores are embedded in a gelatinous mass, which retains its globular form even after the disappearance of the diffluent zone, and the cuticularised hemisphere remains seated upon this like a cap; its edges, however, usually curl up somewhat, and it frequently loses its regular shape, becoming angular and puckered (Fig. 5). If sufficient moisture be present, the gelatinous mass swells up by imbibition of water, and with the contained spores protrudes through the open zone in a very characteristic manner (Fig. 5). These phenomena, which follow from the disappearance of the diffluent zone, constitute the *dehiscence* of the sporange, and are displayed by all the Pilobolidæ. This group is divided into two genera, Pilobolus* and Pilaira,† which are distinguished by the mode in which they effect the dispersion of their sporangia, the mode in each case being intimately

* From πῖλος, *a hat*, and βάλλω, *I throw*.

† From πῖλος, and αἴρω, *I raise*.

connected with the structure of the stem, which differs considerably in the two genera.

In Pilobolus the stem is separated from the mycelium at its base by a transverse septum, and at its summit, just beneath the sporangium, it swells out into an ovoid or globular form, and, as we shall see presently, the sporange is violently projected when mature, sometimes to an enormous distance. The height of a species of Pilobolus rarely exceeds one inch, and is usually very considerably less. In the other genus the stem rises to a greater height, in one species even to four inches, and remains slender and cylindrical throughout. When the sporânge is mature the stem loses its stiffness, and, as it falls upon the substratum, the sporange is quietly deposited at a greater or less distance. Corresponding to this absence of projection of the sporange is the absence of the septum at the base and of the swelling at the summit of the stem. We may then subdivide the Pilobolidæ as follows:—

Sporange violently projected. A swelling at the summit and a septum at the base of the stem	PILOBOLUS.
Sporange not projected. No swelling at the top of the stem, no septum at the base	PILAIRA.

We will now proceed to consider the minute particulars of the structure and development of the genus Pilobolus and the many interesting questions connected therewith. The description is mainly founded upon my observations of *Pilobolus Kleinii*, but will apply, *mutatis mutandis*, to the other species.

(To be continued.)

GEOLOGICAL MAP OF NOTTINGHAM.

We are glad to learn that the large Geological Map of the borough of Nottingham which was exhibited at the *soirée* held in connection with the visit of the Midland Union to Nottingham in 1882 has now been published. It has been copied on the reduced scale of $3\frac{1}{3}$ inches to a mile, or one-fourth the size of the original, and incorporated in Dr. Seaton's report to the Town Council, on the "Sanitary Condition of Nottingham in 1882." The geological formations included within the limits of the borough boundaries are the Coal Measures, the Permian Lower Magnesian Limestone and Marl, the Lower Mottled Sandstone, Bunter Pebble Beds, Lower Keuper Basement Beds, "Waterstones," and Upper Keuper Marl of the New Red, and the alluvial deposits of the Trent and the

Leen. Each of these formations, save the Keuper Basement Beds, which are scarcely at all exposed at the surface of the ground, is well represented, and is indicated in the map by a separate colour and index sign, the latter being the same, and the colours mostly the same, as those used on the maps of the Government Geological Survey. As might be expected, the boundaries of the formations are represented in more detail than could be expected on the one-inch-to-a-mile scale, besides possessing the advantage of having been traced by one who, through living on the spot, was able to profit by the excavations continually being made in the neighbourhood during a long course of years. The "faults" are all carefully traced, and although their course is only indicated by a black line, the same as the boundaries of the formations, the abrupt termination of a patch of colour along a more or less straight line indicates pretty clearly where the boundary is a line of fault. A marked feature of the map is the broad strip of alluvium of the Trent that runs across the bottom of the map. This is of course indicated by the orthodox "flying crows," a single crow indicating areas where the surface is composed of silt or brick-earth, three crows where it is known to be composed of gravel. And so with regard to the alluvium of the Leen; though these minutiæ have been somehow omitted from the index. The occurrence of drift-sand, clay, and gravel is indicated by those words printed on the map where such deposits were observed. From the frequent recurrence of the terms "drift-sand," "drift-sand and pebbles," and so on, on the west side of the borough, while they are absent on the higher ground of the east, we gather that what drift there is occurs along the west side of the area covered by the map. Most of the quarries and gravel pits on the west side of the borough appear to be marked on the map, while arrows show the direction of the dip of the rocks. But the positions of the brickyards, which we happen to know exist on the east, and where the Upper and Lower Keuper are well exposed, are unfortunately omitted. This, we understand, was owing to a fear lest the geological information should crowd out or interfere with the other features the map was designed to illustrate. The map is described as made "from the Ordnance plan, re-surveyed and amended in detail by J. Shipman, of Nottingham, and approved by W. Talbot Aveline, F.G.S., &c." Indeed, Mr. Aveline, we are informed, guarantees its accuracy. But this scarcely does justice to the extent of Mr. Shipman's labours, as anyone may see for themselves by comparing the map with the one-inch map (71 N.E.) of the Government Survey. The map contains the results of all the latest researches into the geology of Nottingham, even to the separation of the Keuper Basement Beds from the "Waterstones," which was decided on by the Geological Survey in 1880, though the occurrence of one minute strip of these rocks at the foot of Colwick Hill, east of Sneinton, was, we understand, accidentally omitted. The borough of Nottingham is about five miles in width by about seven miles in length, and the work of mapping this large area extended over five years. Some parts of the area were exceedingly complex and difficult, being much broken up by faults and obscured by drift, so that a long iron spud became an indispensable companion in the field-work for a long time. Mr. Shipman found his friend Mr. Talbot Aveline, F.G.S., (who has now retired from the Survey after forty-two years' service) always ready to help him with kind advice or other assistance whenever it was needed, and the first of the nine sheets into which the original map is divided was surveyed under Mr. Aveline's personal supervision. The physical features of the ground are indicated by means of contour lines for every thirty feet, and these are the work of Mr. Fred. Jackson, C.E., of Nottingham. Altogether, geologists who take an interest in the geology of Nottingham will feel grateful to Dr. Seaton for enhancing the value of his book—itself a model of what a Medical Officer of Health's report should be—by rendering available this new map of Nottingham. It may be mentioned that copies of the book are to be had gratis by applying to the Health Department at the Municipal Offices, Nottingham, and we certainly advise every one interested in the geology of the Midlands to endeavour at once to obtain a copy of Mr. Shipman's very admirable map.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT PETERBOROUGH.

The members of the Peterborough Natural History and Scientific Society have for some time been steadily at work preparing for the sixth annual meeting of the confederated scientific societies of the Midland Counties. The previous meetings have been held at Birmingham, Leicester, Northampton, Cheltenham, Nottingham, and Tamworth. From the considerable local attractions, and from the energy always displayed by the local society, the forthcoming meeting at Peterborough bids fair to be a most successful one, and we earnestly advise the members of the Union not to miss the opportunity of so pleasant an outing combined with so good a motive, and affording the prospect of so much real instruction.

PROGRAMME FOR THE FIRST DAY.

The arrangements as at present sketched out include a meeting of the Council and the General Meeting of the members on Wednesday, the 25th of June. On this day visitors will be shown various places of interest in the town, the chief point being of course the Cathedral.

In the evening a Conversazione will be held in the Fitzwilliam Hall (kindly lent for the occasion by Mr. Alderman Nicholls), when collections illustrating the natural history of the neighbourhood will be exhibited, together with ancient and modern works of art, objects under the microscope, &c. The chief feature of the display will be an attempt to illustrate the natural history and antiquities of the Fens, so rich in relics of all kinds. Short addresses will be delivered during the evening.

SECOND DAY, THURSDAY, JUNE 26TH: THE EXCURSIONS.

Two Excursions will be arranged for the second day of the meeting, and it may be safely said that more interesting and inviting trips have never been offered.

EXCURSION No. I.: TO STIBBINGTON HALL, BEDFORD PURLIEUS, AND CASTOR.

The route will be *via* Chesterton (the birth-place of Dryden), inspecting the church, and crossing the old Roman road known as Ermine Street; thence to Water Newton (where the river-gravels have yielded Roman pottery and bones) and Stibbington Hall, where (by the kindness of Capt. J. Vipan) the Orchid Houses and the magnificent collection of Indian objects will be visited. From this point the carriages will proceed to Wansford, visiting the beds of Inferior Oolite (rich in plant-remains), and so on to Bedford Purlieus—the haunt of many rare plants and insects.

The return journey will be by Sutton Marsh, where such plants as *Menyanthes*, *Parnassia*, *Anagallis tenella*, *Samolus*, *Pinguicula*, *Gymnadenia conopsea*, and *Eriophorum* are still to be found, and Castor—the *Durobrivæ* of the Romans—so famous for the discoveries made there of ancient kilns, still full of Roman pottery.

EXCURSION No. II.: THE DECOY, AND CROYLAND ABBEY.

The second excursion will proceed to the Decoy in Borough Fen, where all the operations of catching wild-fowl in this remarkable manner will be shown. Thence the party will proceed to the famous Croyland Abbey, and thence again to Thorney Abbey. The entire route is full of special interest to the botanist, the archæologist, and the ornithologist.

Of each of the excursions, so ably planned by our Peterborough friends, it may be said that only fine weather is required to cause them to live as red-letter days in the memory of every person taking part in them.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER IV.

Proximate Definition of Life.

BY FREDERICK JOHN CULLIS

In this and the two following chapters Mr. Spencer discusses the important question "What is Life?" commencing by a brief consideration of some previous answers:—That of Schelling, "Life is the tendency to individuation"; That of Richerand, "Life is a collection of phenomena which succeed each other during a limited time in an organised body"; that of De Blainville, "Life is the twofold internal movement of composition and decomposition, at once general and continuous"; a former definition of Mr. Spencer's "Life is the co-ordination of actions"; and that of G. H. Lewes, "Life is a series of definite and successive changes, both of structure and composition, which take place within an individual without destroying its identity."

Mr. Spencer then makes choice of the processes of assimilation, and of reasoning, as illustrative of the lower and higher manifestations of life, respectively; and shows in succession that they are both processes of *change*—of *successive* changes—of *simultaneous* successions of changes—of simultaneous successions of *heterogeneous* changes—of *combinations* of simultaneous successions of heterogeneous changes—of *definite* combinations of simultaneous successions of heterogeneous changes.

This series of characteristics being found to apply equally to both these widely differing manifestations of vitality, Mr. Spencer incorporates them in his proximate definition, "*Life is the definite combination of heterogeneous changes, both simultaneous and successive.*" But in conclusion he declares the definition to be essentially defective, omitting the peculiarity of which we have the most familiar experience, and with which our notion of Life is more than with any other associated; and which forms the subject of the next chapter.

ON A SLATY CONGLOMERATE IN THE ROCKS OF CHARNWOOD FOREST.

BY H. E. QUILTER, OF LEICESTER.

It is no doubt well known that the rocks of Charnwood Forest are the remains of a volcanic district, consisting chiefly of volcanic agglomerates, ashes, and slates. One or two of the sections show, interstratified with them, bands of pebbles not more than 4 or 5 inches in thickness; the one which I shall refer to and describe is interstratified with ashy slate, and is exposed near The Holgates, Bradgate Park.

Conglomerates, as a rule, are usually interesting from the well-known association of physical conditions under which they have been formed, but when associated with ashes and slates of volcanic origin their interest becomes augmented, and the physical conditions under which they have been formed are somewhat more complex.

This conglomerate is mentioned by Messrs. Hill and Bonney, in their researches in these Charnwood rocks, as "a conglomerate of slaty pebbles with felspathic fragments." A close examination reveals the fact that this conglomerate has been acted upon by the same force or forces that induced the cleavage in the slates with which it is interstratified, splitting up the pebbles, so that very few are perfect.

The matrix is a grit, composed mainly of rounded quartz grains; the pebbles are well rolled and waterworn, and range in size from 1 to 3 or 4 inches in their longer axis, and consist chiefly of quartzose rock, with small crystals of quartz about $\frac{1}{16}$ of an inch in size scattered throughout. Pebbles of jasper are not uncommon; a few are of the rocks of the district, one being composed of the pinkish felsite fragments so common in the agglomerates of the district, and another of coarse pinkish quartzose slate, with embedded angular fragments of fine-grained green slate. Messrs. Hill and Bonney think that these rocks afford evidence of the existence of lakes, into which some of the ashes of the volcanoes fell to form slates; and it is evident that water must have had something to do in the formation of this conglomerate; the water must also have been in motion, either as tidal action in an extensive lake or as running water, to convert the rough pieces of rock into rolled pebbles.

Dr. C. Callaway, in the "Geological Magazine," 1881, gives an instance of conglomerates in some other older rocks that were formed by contemporaneous denudation:—"A lava flow reaching the sea shore and becoming consolidated would, in a short time, be worn away by the action of the water, and, forming pebbles, be mixed up with the shingle already present; the addition of a cementing material would soon form a conglomerate, which, as the volcano grew, would be covered up either by lava flows or by ejected ashes from the crater."

This course of events could only follow when the volcano was situated near the sea coast or as a volcanic island in the seas of that time. If this was the case in our Charnwood rocks the upheaval and depression required could be explained. If, on the other hand, this conglomerate was deposited on the shores of a lake, bounded or surrounded by volcanoes, we should expect to find the pebbles composed almost entirely of the fragments ejected from them, together with fragments of ashy rocks that would fall from their sides.

Although the majority of the pebbles cannot be correlated with any known exposure of the Charnwood rocks, it is very probable that the parent rocks have been removed by denudation. The presence of the small crystals of quartz in the majority of them would seem to indicate that the rock of which they are composed cooled slowly, and, from its appearance, it is probably a volcanic lava; so that the supposition of contemporaneous denudation is somewhat strengthened, but whether formed on a lake or sea shore cannot be said. The lake theory is, however, the most probable, as there are no indications of any other than shallow water deposits in the whole series of the Charnwood rocks, and with regard to the depression and upheaval required, the unstableness of level of volcanic districts is well known.

METEOROLOGICAL NOTES.—March, 1884.

Temperature was low at the commencement of the month, and the sky generally overcast or cloudy. There was a considerable fall of rain and snow (0·64in.) on the 3rd. A sudden rise of the barometer on the 4th was accompanied by temporary improvement. From the 6th the barometer fell somewhat rapidly, reaching its lowest point for the month (29·132in.) on the 10th. From thence it rose rapidly to the 14th, and a short spell of summer-like weather continued till the 19th. The highest temperatures were recorded on the 16th, viz., 69·1°, at Loughborough; 68·4°, at Hodsock; 66·8°, at Coston Rectory; and 66·1°, at Strelley. These values are unusually high for the month of March, but are in no degree an indication of an early summer, as the sequence has already proved. From the 19th the barometer continued high, with an undulatory movement, till the 29th, after which it fell to about 29·5ins. on the 31st. Towards the close of the month the temperature was again low, with an overcast sky, and much damp in the air. A minimum reading of 24·1° was recorded at Hodsock on the 1st, but the sheltered thermometer fell below 32° on a few nights; on the grass, however, frosts were very frequent. The rain-fall was about the average; sunshine below the average. Lunar halos were observed on the 3rd, 7th, 9th, and 11th. The wind was rather light for March, blowing principally from N.E. and S.E., and rarely reached the force of a strong breeze. Vegetation was in a forward state, the foliage on the hedgerows appearing on the 15th, and plum trees being in full blossom on the 20th.

WM. BERRIDGE, F.R.Met.Soc.

12, Victoria Street,
Loughborough.

ERRATUM.—In the notes for February, a minimum on the grass is attributed to Coston Rectory, whereas it was recorded at Hodsock. —W.B.

THE LARK AND THE THRUSH.

The lark is found all over the British Isles but is less numerous on the Western Isles and extreme North of Scotland, especially in winter. Larks may be seen in large flocks in the autumn. In winter the foreign larks return to the Continent; the stay-at-home birds take up their quarters in arable and moor lands.

The habits of this bird are worthy of observation. By the conformation of its claws it is naturally adapted to perching on the ground; by its length and power of wing, for soaring high in the air; it never perches on a tree. The following description of its flight is from Gould: "Rising as it were by a sudden impulse from its nest, it bursts forth while as yet a few feet from the ground into exuberant song, and with its head turned towards the breeze, now ascending perpendicularly, now veering to right or left, but not describing circles, it pours forth an unbroken chain of melody, until it has reached an elevation computed to be at the most 1,000 feet. To an observer on earth it has dwindled to the size of a mere speck, but it never rises so high as to defy the search of a keen eye." "Having reached its elevation," he says, "its ambition is satisfied with a series of droppings with intervals of simple hovering, during which it seems to be resting on its wings. Finally, as it draws near the earth it ceases its song and descends more rapidly, but before it touches the ground it recovers itself, sweeps away with almost horizontal flight for a short distance, and disappears in the herbage." "In performing this evolution it has been known to take 15 to 20 minutes." It is remarkable as being the only bird which sings in its flight. Perhaps, if we had never seen or heard one, we could only suppose that those who said they had were "drawing upon their imagination." It ceases to sing in July and begins again in October. It begins its song at sunrise and has been heard in Cornwall as late as 11 o'clock at night. It sings in its cage hanging at the door of the poor man's cottage in the country or dark alley of some smoky town, with as much spirit as if its six inches of turf could be measured by acres, and the roof of its little cage were the vault of heaven.

To live in a country having such a charming accompaniment as the skylark should be a source of great happiness. The Americans regret its loss and the blank is felt in Australia—so much so that they have tried to import the bird into both countries; but "Nature's law is strict and difficult to understand," and whenever the experiment has been tried it has failed.

For a thorough appreciation of the lark's song we should turn to the Life of a Scotch Naturalist, Thomas Edward. "Next to the mavis, the Lark or Laverock," he says, "is the bird for me, and has been since I first learned to love the little warblers of the woods and fields. How oft, oh! how oft, has the lark's dewy couch been my bed, and its canopy, the high azure vault, been my only covering, while overtaken by night during my wanderings after Nature; and oh! how sweet such nights are—and how short they seem—soothed as I have been to repose by the evening hymn of the lark, and aroused by their early lays at the first blink of morn."

The thrush is a bird of no less interest to all Europeans. It is distributed all over Europe as far north as Norway, and Cape Wrath in Scotland. Macgillivray's account of the thrush is perhaps the best. He says: "It is associated in my memory with the Hebrides, where it is perhaps more abundant than in most parts of Britain. There, in the calm summer evening, when the sun is setting and shedding a broad glare of ruddy light over the smooth surface of the ocean, when no sound comes over the ear save at intervals the faint murmur of the waves rushing into the caverns, the song of the thrush is poured forth from some granite rock, and returns with softer and sweeter modulations from the sides of the heathy mountains. There may be wilder and more marvellous songs, and the mocking bird may sing the requiem of the Red Indian of the Ohio, or cheer the heart of the ruthless oppressor—the white man of many inventions: but to me it is all-sufficient, for it enters into the soul and melts the heart into tenderness. In other places the song of the thrush may be lively and cheering: here in the ocean-girt solitude it is gentle and soothing." Its song is heard at all seasons, but especially in winter and summer, not only in sunshine but often in the midst of rain.—Rev. E. Davenport, *Wellington College N. S. Society's Report.*

Natural History Notes.

A Floral Register.—The following register of spring-flowering plants, showing the dates of flowering at the Royal Botanic Garden, Edinburgh, during 1883 and 1884, has been obligingly sent to us by the Secretary of the Edinburgh Botanical Society:—

		1883.		1884.	
1.	Adonis vernalis	April	8	March	26
2.	Arabis albida	Feb.	19	Jan.	23
3.	Aubrietia grandiflora	Feb.	15	Feb.	10
4.	Bulbocodium vernum	Feb.	6	Jan.	26
5.	Corydalis solida	March	30	March	13
6.	Corylus avellana	Jan.	26	Jan.	14
7.	Crocus susianus	Feb.	9	Jan.	19
8.	,, vernus	Feb.	17	Jan.	28
9.	Daphne Mezereum	Feb.	10	Jan.	20
10.	Dondia epipactis	Feb.	6	Dec. (1883)	29
11.	Draba aizoides	March	12	Feb.	12
12.	Eranthis hyemalis	Jan.	27	Jan.	22
13.	Erythronium Dens-canis	March	24	March	12
14.	Fritillaria imperialis	April	9	March	27
15.	Galanthus nivalis	Jan.	25	Jan.	19
16.	,, plicatus	Feb.	6	Jan.	26
17.	Hyoscyamus scopolia	April	3	March	20
18.	Iris reticulata	March	2	Feb.	28
19.	Leucojum vernum	Feb.	4	Jan.	26
20.	Mandragora officinalis	Feb.	20	Feb.	9
21.	Narcissus pseudo-narcissus	April	2	March	18
22.	,, pumilus	March	12	Feb.	28
23.	Nordmannia cordifolia	Feb.	20	Feb.	15
24.	Omphalodes verna				
25.	Orobus vernus	March	30	Feb.	9
26.	Rhododendron atrovirens	Feb.	10	Jan.	10
27.	,, Nobleanum	Feb.	22	Feb.	2
28.	Ribes sanguineum	March	28	Feb.	20
29.	Scilla bifolia	Feb.	20	Feb.	14
30.	,, ,, alba	March	3	Feb.	21
31.	,, præcox	Feb.	7	Jan.	20
32.	,, Sibirica	Feb.	16	Jan.	30
33.	,, taurica	March	3	Feb.	24
34.	Sisyrinchium grandiflorum	Feb.	22	Feb.	14
35.	,, ,, album	Feb.	22	Feb.	12
36.	Symphytum caucasicum	April	10	Feb.	15
37.	Symplocarpus fœtidus	Feb.	8	Feb.	4
38.	Tussilago alba	Feb.	6	Jan.	18
39.	,, fragrans	Jan.	15	Dec. (1883)	26
40.	,, nivea	April	1	Feb.	14

Gardeners' Chronicle.

HANDSWORTH.—I heard the note of the Cuckoo here on Saturday morning, the 26th inst., and I saw in a friend's garden, in the afternoon of that day, two swallows which appeared to have just arrived. —W. R. HUGHES, 28th April, 1884.

ANTEDON (COMATULA) ROSACEUS.—It may be interesting to record the fact that a small specimen of the rosy feather-star, measuring 1½ in. in length, was picked up by me on the shore at Brixham during the easterly gales that prevailed in Easter week. It will be remembered that on the occasion of the first Dredging Excursion of the Birmingham Natural History and Microscopical Society to Teignmouth in 1873 one or two specimens of this beautiful star-fish were dredged in Torbay in the stalked condition.—W. R. HUGHES, 28th April, 1884.

GEOLOGISTS who study the Lias may like to know of the formation of an extension of railway at Market Harborough. The Lower, Middle, and Upper Lias are exposed—the Upper and Middle in the embankments. The representative of the marlstone is rather thinner than at the Harborough brickyard, although of the same character. In a field dug to the extent of 14ft. for ballast, 7ft. of Mid-Lias clays were exposed, and underneath 6ft. of Lower Lias. This was full of nodules, containing Ammonites capricornus and a few other well preserved fossils. The Middle Lias was very unfossiliferous; the clays of the Upper Lias yielded some good fossils.—H. E. QUILTER.

FLORA OF BRITISH FUNGI (HYMENOMYCETES).—The Rev. John Stevenson, author of "Mycologia Scotica," and honorary secretary of the Cryptogamic Society of Scotland, announces the intended publication of a book with the above title, illustrated by Worthington G. Smith, F.L.S. The work will contain full descriptions of all British Hymenomycetes (chiefly Agaricini, Mushrooms, and Toadstools), with habitats, seasons of growth, &c., &c. Edible and poisonous species will be specially noticed and commented on. All genera and sub-genera will be figured. The illustration of sub-genera will supply a much-felt want, and will greatly facilitate the study of Agarics. It may be added that the value of the flora will be much enhanced by embodying the views of Fries, contained in his "Monographia Hymenomycetum Sueciæ." The work will extend to two volumes at 10s. 6d. each, and the names of subscribers may be sent to the Rev. John Stevenson, Glamis, Forfarshire, N.B.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, April 1st.—Mr. J. E. Bagnall exhibited *Hypnum polymorphum*, new to Warwickshire; *H. glareosum*, rare; *H. piliferum; H. pumilum*, rare; *Tortula intermedia*, rare; *Fissidens* *tamarindifolius*, rare; *Camptothecium lutescens*, and other mosses from Henley-in-Arden, also on behalf of Dr. M. C. Cooke, *Odontia fimbriata*, *Merulius corium*, and a singular alga found in the lakes of Scotland—*Cladophora ægagropila*. Mr. W. H. France then read his paper on the "Ethics of Sociology," which will be published in a future number. Biological Section, April 8th.—Mr. R. W. Chase in the chair. Mr. J. B. Stone, J.P., presented a copy of his recent work—"Children in Norway; or, a Holiday on the Ekeberg"—to the library of the Society. Mr. J. E. Bagnall exhibited *Viola permixta*, Compton Verney; *Festuca rubra*, var. *fallax*, Earl's Wood, both new to the county; Mosses:—*Bryum uliginosum*, Ansty, near Coventry; *Tortula fallax*, var. *brevifolia*, Earls Wood, both new to the county; *Campylopus brevifolius*, var. *elongatus*, banks of the Wye, near Builth, and other rare mosses. Lichens:—*Cetraria aculeata*, from Sutton Park and Baddesley Common, new to the county; *Usnea florida*, *Ramalina cuspidata*, etc. For Dr. M. C. Cooke, *Hymenochæte tabacina*, *Radulum orbiculare*, and other fungi. For Mr. Towndrow, *Juncus tenuis*, from Cradley, Hereford, new to England. Mr. W. H. Wilkinson then read a paper, "The Study of a Lichen from Oban—*Ricasolia amplissima*." After giving a graphic description of the physical features of Oban, and briefly glancing at some of the more noticeable natural phenomena of the district, he passed on to describe the minuter structure of *Ricasolia*, the gonidial stratum, the medullary layer, the apothecium, with its asci, paraphyses and spores, the spermogones and their spermatia, and the soredia, all of which were ably and minutely described, their minute details fully dwelt on, and their functions, or supposed functions, fully and carefully discussed. The paper, which was both interesting and instructive, was rendered the more so by a series of sections, showing the various structures noticed in the paper, together with drawings representing the plant, natural size, and figures of the various parts magnified, also by black-board illustrations, and specimens of various groups of lichens. A discussion followed, in which Mr. R. W. Chase, Mr. J. Morley, and Mr. J. E. Bagnall took part. Geological Section, April 22nd.—Mr. R. T. Brain exhibited a remarkable concretion found in a paving stone, in Ashton-under-Lyne, the property of Superintendent Wilcox. Mr. J. E. Bagnall exhibited some plants, collected by Mr. Hughes in Devonshire, and some mosses and lichens from this county, and mosses from Cumberland. Mr. W. R. Hughes exhibited, on behalf of Mr. John Carey, F.R.G.S., of Brixham, specimens of moss agate from India. Mr. J. F. Goode exhibited a slide of entomostraca tests and foraminifera, obtained at Oban, mounted in balsam. Mr. T. H. Waller exhibited chips from the boulders dislodged in the neighbourhood of King's Norton, in the making of the new Midland line, collected by Mr. C. Pumphrey. Mr. W. P. Marshall called attention to the remarkable astronomical fact that all the planets known to the ancients are now visible at one time, and that the moon will pass under each one in the course of the next fortnight. One effect of all the planets being on one side of the sun was stated to be that the centre of gravity of the whole solar system is at present nearly at its maximum distance outside the globe of the sun. Mr. W. P. Marshall then read a very interesting paper on "The volcanic origin of the recent remarkable sunrises and sunsets," which will appear in a future number. Mr. Marshall exhibited a large mass of the floating pumice picked out of the sea, and some of the ashes which so thickly covered the ship "Berbice," which was about forty miles from Krakatoa at the time of the eruption. These had been sent to the members of the society by Captain Ross, whose steam yacht the

Society used at Oban last summer. Mr. T. H. Waller gave the analysis of the pumice and ashes, and compared them with the results published by the Abbé Renard, and with the analysis of the lavas from the last eruption of Santorin. SOCIOLOGICAL SECTION.—At the ordinary meeting of the Section, held on Thursday, April 24th, in the Society's Room at Mason College, the President, Mr. W. R. Hughes, F.L.S., in the chair, it was unanimously resolved that the President be requested to write, on behalf of the Section, a congratulatory letter to Mr. Herbert Spencer on the occasion of his sixty-fourth birthday, which occurred on Sunday, April 27th. Mr. F. H. Collins also presented to the Society, through the Section, a framed portrait of Mr. Spencer, which was accepted with thanks. The study of Mr. Spencer's "Principles of Biology" was then continued, chaps. 3 and 4 of Part II. being very ably expounded by Mr. C. H. Alison.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 17th.—Microscopical and General Meeting. Mr. Darley exhibited a hibernated larva of *Lasiocampa roboris*, and called attention to the great difference in time these insects remain in the pupal stage, varying from three weeks to eleven months; Mr. Delicate, yellow bunting; Mr. Boland, two large, brilliant beetles from Colombo. The following objects were shown under the microscopes:—Mr. Hawkes, *Euglena viridis* and circulation of blood in a stickleback, also *Trichodina pediculus*, parasitic on the same; Mr. Moore, alimentary canal of *Forficula auricularia*; Mr. Tylar, earth mite (*Trombidium holosericeum*); Mr. Insley, two slides, showing shrunken protoplasm in cells of leaf of iris, and bulb of onion, illustrative of Professor Hillhouse's paper. March 24th.—Mr. Madison exhibited a number of shells of *Limnæa stagnalis*, showing the extent to which they vary in size in different localities; under the microscopes Mr. Tylar showed zoëa of shore crab; Mr. Hawkes, ova of *Anodonta cygnea*, living; Mr. Moore then read a paper "Notes on the Common Flea." The paper described its place in the animal kingdom, and the egg, larva, pupa and imago, their external appearance and internal structure. The paper was illustrated by a series of microscopic preparations, notable amongst which was one showing œsophagus, gizzard, stomach, and Malpighian tubes, etc., and another the development of embryo in egg. March 31st.—Mr. Tylar, a hydroid zoophyte, *Halecium halecinum*, with tentacles expanded. April 7th.—Mr. Deakin exhibited several specimens of the moth, *Nyssia zonaria*, from the Cheshire Sandhills, also a collection of shells from the Hamstead district; Mr. Madison, a specimen of *Limnæa peregra*, var. *picta*, from Hall Green; Mr. Hawkes, a collection of plants from Northfield, including, among others, *Ribes grossularia*, *Petasites vulgaris*, *Veronica buxbaumii*, and *Chrysosplenium alternifolium*. The following were shown under the microscopes:—Mr. Tylar, a zoophyte (*Campanularia*), overgrown with diatoms; Mr. J. W. Neville, a fungus, paper mildew (*Myxotrichum chartarum*). Mr. J. A. Grew then read a paper on "Plant Cells," which described the manner in which plants are built up by cell aggregation, also the various parts of cells, the cell wall, protoplasm, nucleus, and nucleolus. The many forms of cells composing cellular, stellate, vascular, and woody tissues were explained, and also the cell contents—starch, crystals, and chlorophyll, the pretty arrangement of the latter in some of the desmids being referred to. A description of cell division, plant hairs, and stomata concluded the paper, which was illustrated by diagrams.

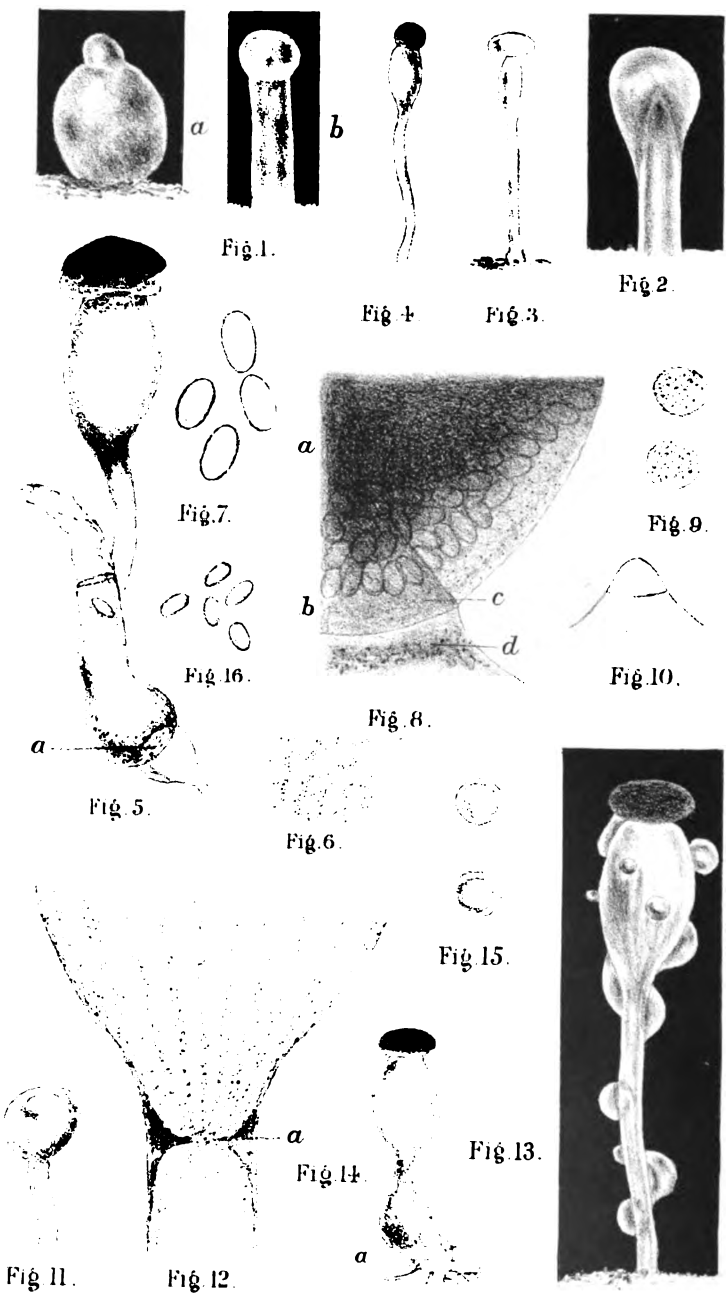
BIRMINGHAM AND MIDLAND INSTITUTE SCIENTIFIC SOCIETY.—On Good Friday, April 11th, nineteen members and friends visited Holt Fleet and Shrawley from Droitwich, under the guidance of Mr. C. J. Watson. The excursion was highly enjoyed, the country exhibiting masses of flowers scarcely ever seen before in such perfection, the cherry trees and the primroses being especially beautiful. Six of the party were energetic photographers, who secured pictures of many a pleasant spot, and finally photographed the party. An excellent tea was partaken of at the Hampstall Ferry Inn, and the return made in good time from Hartlebury at 7.10 p.m.

NOTTINGHAM NATURALISTS' SOCIETY.—April 1st.—The members of this society met together to receive several short communications: the first was from Mr. R. A. Rolfe, of Kew, on "Nottingham Crocuses;" Mr. L. Lee then read a short paper on "The Oxlip and Cowslip," after which Mr. C. T. Musson introduced a few notes on "Our Local Land and Fresh Water Shells." April 5th.—The first country ramble of this season was to Lambley Dumbles. There was a fair attendance of members. During the afternoon each member devoted himself to his particular study, and numerous botanical specimens, land and fresh water shells, hydrozoa, etc., were collected and reserved for future observation. Although the weather was somewhat showery, a very pleasant afternoon was spent, and it is hoped that the members will encourage, by their attendance, the organisation of these country rambles, which will be arranged at short intervals during the summer months. April 15th.—The Quarterly Microscopical Gathering was arranged for this date, but partly owing to the uncomfortable state of the weather, and partly to the Easter Holidays, there was not a good attendance, and the meeting was adjourned.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—All the six "Gilchrist" Lectures, recently given under the auspices of the Society, were well attended, and notwithstanding the small charge for admission—one penny each lecture, except to a few reserved seats—there has been a profit of about ten pounds, which is to be devoted to the purchase of books relating to the various subjects treated of in the lectures, so that those members who wish to pursue the subjects further can do so. To those Societies who have not yet had a course of these lectures, our advice is, try and arrange for one during your next session.

TAMWORTH NATURAL HISTORY, GEOLOGICAL, AND ANTIQUARIAN SOCIETY.—On March 24th Rev. Wray W. Hunt read a paper on "Apparitions." There was a crowded meeting, and an animated discussion followed the delivery of the paper. On April 7th Professor W. Hillhouse, of Mason Science College, Birmingham, gave his lecture on "A Fallen Leaf," in the Tamworth Town Hall. This was the first of the Society's public lectures. The room was well filled with an appreciative audience. The choice of Professor Hillhouse was decidedly a happy one, and it is to be hoped that the success of this lecture will lead to an increased number of public lectures. Both the above lectures can be found printed *in extenso* in the *Tamworth Herald* of April 12th.

Plate IV.



Lith Birm

THE PILOBOLIDÆ

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 135.)

§ 3.—Pilobolus.

It has already been mentioned how specimens of Pilobolus can be readily obtained. They can also be found on not quite fresh cow or horse dung in sheltered places, but not so easily, for a reason which will be evident hereafter, as by growing them within doors. It is evident that the spores must be very widely diffused; they exist in the dung when it is brought in from the road or field, and considering how often they make their appearance under these circumstances, we must allow that they are constantly eaten by the animals with their food, probably with the grass, and then pass

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PLATE IV.

DESCRIPTION OF THE FIGURES.

Fig. 1*a*. A basal reservoir, which happened to be above the surface of the matrix × 45.

b. Top of the stem, showing the commencement of the sporangium × 45.

Fig. 2. The apex of a stem, excreting a large transparent globe of fluid × 45.

Fig. 3. A stem, with the columella just formed × 20.

Fig. 4. Another, a little more advanced × 20.

Fig. 5. A stem which had been injured, and has put forth a new perfect stem from below the injured part × 30.

Fig. 6. Arrangement of the granules in the sporangium, just before the formation of spores.

Fig. 7. Spores of *P. Kleinii* × 500.

Fig. 8. Base of sporange showing the black cap (*a*), the diffluent zone (*b*), the columella (*c*), and the granules heaped in a ring at the summit of the swelling (*d*) × 500.

Fig. 9. Spores of *P. Kleinii*, forma *sphærospora* × 500.

Fig. 10. Columella × 50

Fig. 11. Stem which has thrown off its sporange × 30.

Fig. 12. Base of swelling, showing (*a*) the pseudo-septum of Coemans, and the meridional streams of granules × 80.

Fig. 13. A perfect specimen of *P. Kleinii* × 45.

Fig. 14. *P. œdipus*; *a*, the mycelian apophysis × 20.

Fig. 15. Spores of *P. œdipus* × 500.

Fig. 16. Spores of *P. eu-crystallinus* × 500.

All the figures are drawn from *P. Kleinii*, except 9, 14, 15, and 16; they are all from nature.

through the intestines unharmed. That they are not confined to grass, however, is seen by the fact that, when the dung of a pig fed almost entirely upon meal was taken direct from the stye, it also produced an abundant crop after a few days' sojourn under the bell glass.

The spores of different species, when cultivated artificially, exhibit very different powers of germination. Those of *P. œdipus*, for instance, when placed in pure water, emit germ tubes within twenty-four hours; the same thing takes place in a damp atmosphere, even while the spores are still contained within the sporangium. The spores of *P. Kleinii*, on the contrary, will not germinate in pure water, but only in a decoction of dung or other nutrient medium.

a.—The Mycelium.

The spores germinate in the ordinary way by the emission of one or more germ tubes which branch repeatedly. When fully formed, the mycelium consists of a number of continuous main filaments, which bear branches of two kinds, (1) long, narrow, tapering, much-divided, thin-walled branches, ultimately cut off by a septum, the object of which is to permeate the substratum in search of food, and (2) shorter bladder-like processes, which appear to be only swellings of the membrane of the main filament, from which they are not divided by a septum; these latter are probably intended merely to increase the extent of absorbing surface.

The contents of the mycelium are of five kinds, besides the watery cell-sap; (1) a homogeneous hyaline protoplasm, (2) a number of rounded yellow granules floating therein, (3) a quantity of a red oil in minute globules, (4) a crystalloidal substance, called by Van Tieghem *mucorine*, the octahedral crystals of which may be found floating in the cell-sap, especially in the later stages of development, and (5) glycogen, or animal starch, which may be recognised by the peculiar rosy-red tint which it assumes with iodine. The protoplasm of the mycelium is, according to Klein and Van Tieghem, in continual movement, which, however, it is difficult to observe unless large uninjured portions of the mycelium can be obtained. This movement is at first of a circulatory character, but after a time it manifests a predominant tendency towards some particular point.

At this point a branch appears which is directed towards the surface even when the mycelial tube is deeply buried in the matrix, and assumes a widely clavate form. Two, three, or more of these, which are destined to produce the sporangia, may arise on the mycelium proceeding from a single spore.

When the end of one of these branches arrives close to, or in some species passes above, the surface, it becomes swollen at the end into a comparatively large rounded vesicle (Fig. 1*a*), into which the dense yellow protoplasm of the mycelium passes and is agglomerated at the upper end. This upper portion of the clavate termination is then cut off from the mycelium by a septum (Fig. 5*a*), but the movement of the protoplasm still vigorously continues, a portion passing upwards through the septum, but apparently little or none returning. This is the function of the septum, to retain the protoplasm in the upper portion, in preparation for the future explosive phenomena. This terminal swelling will be called the *basal reservoir*, because it forms the lower portion of the stem; the conically dilated end of the mycelium, upon which the reservoir is seated, is called the *mycelian apophysis* (Fig. 14*a*). Both these occasionally give off quasi-rootlets resembling the finer branches of the mycelium (Fig. 14).

b.—The Stem.

When a sufficient supply of protoplasm is accumulated in the basal reservoir the pressure on its walls causes some point thereof, either at the top, or obliquely at the side, to yield and grow outwards in the form of a tubular process, like the finger of a glove (Fig. 1*a*). This rapidly increases in length, remaining of the same diameter, except that it is somewhat acutely pointed at the apex (Fig. 2). Up this stem the streaming motion of the yellow protoplasm still continues; but there is usually visible, just beneath the summit, a clear colourless space, filled only with a watery fluid (Fig. 2). The stem continues to elongate until it attains a height, according to the species, of from one-fortieth of an inch to one inch, in one species even sometimes exceeding the latter height. Its final height depends upon circumstances; the stem of *P. Kleinii*, which usually averages one-tenth of an inch or less, may, when grown in the dark, be drawn out to one inch or more.

c.—Formation of the Sporange.

When the apical growth of the stem ceases the upward streaming of the protoplasm still continues; in consequence, in the first place the acutely pointed apex becomes rounded and then flattened, and finally expanded into a more or less spheroidal vesicle of greater diameter than the stem (Fig. 1*b*). Into this the larger part of the yellow granular protoplasm passes, and finally a flat septum is formed at the summit of the still cylindrical stem, by which the contents of the terminal vesicle are almost completely shut off from communication with the mycelium (Fig. 3). At any rate this vesicle, which is the beginning of the future sporangium, increases very little in size after its first formation, and that little mainly by the upward growth of the septum in a conico-convex form in its interior. We shall see afterwards another reason for believing that very little communication takes place between the stem and the sporange after the separation of the latter. The fungus now presents the appearance shown in Fig. 3, and may be compared to a pin, the head being of a brilliant opaque golden yellow and the stem of a translucent watery or almost milk-and-watery colour. The stem may continue to increase in length by intercalary growth to a certain small extent, after the separation of the sporangium; the average height of the mature fungus is slightly greater than when the sporange is first outlined.

d.—The Sporange.

As soon as the sporange is completely shut off from the stem, changes begin in both parts and proceed simultaneously. We will first notice the changes in the sporange. Hitherto its bounding membrane has been thin, and permitted the yellow granular contents to be seen through; but now it begins to grow thicker and darker in colour, a process which commences at the top and gradually spreads downwards on all sides towards its junction with the stem, but, stopping a little short of this, it leaves a narrow transparent zone belting the sporange immediately beneath the equator, through which the contents are still clearly visible (Fig. 8). During this thickening process the sporange undergoes changes of colour which result from the superposition of the blue-black or brown-black of the cuticle upon the yellow, almost orange, of the contents. After passing through various shades of olive and smoky brown, it finally becomes opaque and, by reflected light, black. When complete it is adorned with little projecting warts, which impart a somewhat rough aspect under a high power, and is encrusted with numerous fine acicular crystals of oxalate of lime. It is also, in *P. crystallinus*, occasionally marked with paler hexagonal reticulations, but the occurrence of these seems to be somewhat fortuitous.

The finished "cap" is rather tough and cartilaginous in texture, though on account of its hollow form it is easily split by pressure. At first, after the formation of the septum, the indurated membrane of the higher portion of the immature sporange shades off gradually, at its lower edge, into the hyaline zone, and, if at this stage the sporange is submitted to pressure, the septum at the base will soonest yield, thus forcing the contents into the stem; nay more, the stem can often be ruptured and the contents forced into the surrounding water, before the sporange itself will yield or burst at any part. But when the sporange is mature all this is altered.

(*To be continued.*)

MR. HERBERT SPENCER'S BIRTHDAY.

At the request of the Sociological Section of the Birmingham Natural History and Microscopical Society we have much pleasure in publishing the following correspondence:—

Wood House, Handsworth Wood,
Near Birmingham,
26th April, 1884.

MY DEAR SIR,

As President of the Sociological Section of the Birmingham Natural History and Microscopical Society, I have been requested on behalf of the Section to convey to you their cordial congratulations on the occasion of your sixty-fourth Birthday, to-morrow, the 27th instant.

In the course of a connected and diligent examination of your great and original system of synthetic philosophy by the members, extending over a period of twelve months, they have repeatedly been impressed, not only with the vastness of the subject itself, but also with the masterly and comprehensive manner in which you have treated it, and with the rich and varied extent of your knowledge and ability in expounding the all-embracing doctrine of Evolution which it unfolds.

The members of the Section unanimously desire me to record their sincere appreciation of the pleasure which the study of your works has afforded them, and they desire me to express the earnest hope that you may be enabled, not only to complete the system which has been the chief work of your life, but also to see its general acceptance in after years.

It may be interesting to mention that one of the members of the Section, Mr. F. Howard Collins, has presented to the Society, as a souvenir of your Birthday, a recent photograph of yourself, suitably framed, to be suspended in the Library.

I am, my dear Sir,
Yours very truly,
W. R. HUGHES.

Herbert Spencer, Esq.

38, Queen's Gardens, Bayswater, London,
April 28th, 1884.

DEAR MR. HUGHES,

Will you please, on the occasion of the next meeting, convey to the Sociological Section my warm thanks for the manifestation of their sympathy. Of the various expressions of kind feeling which from time to time come, in one shape or other, theirs is one of the most pleasing to me.

The hope that I may be enabled to complete my work is one to which I can respond with more satisfaction than for some time past; since I have of late considerably improved in my working power, and have some reason to believe that I may, with care, be enabled presently to resume my ordinary rate of working.

* * *

Believe me,
Sincerely yours,
HERBERT SPENCER.

NOTE.—The paragraph marked * * * referred to a private matter, of no interest to the general public.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(*Continued from page 116.*)

POLYGONACEÆ.—*Continued.*

POLYGONUM.

P. *Fagopyrum*, Linn. *Buckwheat.*
Casual: In cultivated ground and on railway banks. Local and uncertain.
I. New railway banks, Sutton Park, abundant, 1878; Coleshill Heath; Marston Green.
II. Near Wilmcote; Warwick Castle Park, *Herb. Perry;* Kenilworth, *Dr. Baker*, 1880, *Herb. Bab.;* Honily; Stoneleigh; Milverton; Berkswell, *H. B.*

This is frequently sown for feeding game, and cannot, I think, be considered naturalised in any of these stations.

P. Convolvulus, *Linn.* *Climbing Buckwheat.*
Native: In woods, by roadsides, and in cultivated fields and gardens. Common. June to October. Area general.

P. aviculare. *Linn.* *Common Knot Grass.*
Native: In fields, on heaths, by roadsides, etc. Common. June to October. Area as an aggregate species general.

a. agrestinum.
II. Lambcote; Honington; *Newb.* Cornfields, not common, Milverton; Woodloes, *H. B.* I have not noticed this variety, so am not able to give its distribution in the Tame basin.

b. vulgatum.
Area general, most frequent on marly and clayey soils.

c. arenastrum. Local.
I. On heathy waysides near Sutton Park; near Hampton-in-Arden; footway from Henfield to Temple Balsall; canal side near Solihull wharf; Coleshill heath.
II. Honington; Shipston, *Newb.*; Milverton, *H. B.*; Alveston heath; lanes about Allesley village. Appears to prefer sandy and gravelly soils.

d. microspermum. Local.
I. Roadsides between Hampton-in-Arden and Meriden. Fields near Oldbury.
II. Honington; Shipston, *Newb.*; Myton; Kenilworth, *H. B.*; Alveston heath; mostly on clayey or lias soils.

e. rurivagum. Rare.
I. Cornfields near Cornels Ends, Berkswell.
II. Cornfields, Sowe waste; *Kirk, Herb. Bab.*; Hatton, *H. B.*, *Herb. Bab.*; Myton; near Kenilworth, *H. B.*; Halford; Honington, *Newb.*; abundant at Itchington Holt. This variety seems to occur only on heavy soils such as clay and lias.

P. Hydropiper, *Linn.* *Water Pepper.*
Native: In ditches, marshes, damp woods, and by pools. Locally common. July to October. Area general.

P. Persicaria, *Linn.* *Common Persicaria.*
Native: In cultivated fields; by roadsides and on waste heaps. Common. June to September. Area general.
Var. *elatum.*
II. By water, Hasely Reservoir; near Leamington, *H. B.*

P. lapathifolium, *Linn.* *Glandular Persicaria.*
Native: In damp woods, cultivated land, and on waste heaps by roadsides. Locally abundant. July to September.
I. Abundant in Sutton Park; Middleton; Coleshill heath; near Olton Pool; Balsall street.
II. Brailes; St. Dennis, *Newb.*; Warwick; Whitnash, *H. B.*; Alveston heath; Wilmcote, etc.

P. maculatum, *Dyer.*
Native or denizen: On railway banks and waste places. Rare. July.
I. Abundant on newly made railway banks in Sutton Park, 1878.
II. (*nodosum*), Myton Grange fields, *Herb. Perry*; on mud from a bank at Myton, *H. B.*

P. amphibium, *Linn.* *Amphibious Bistort.*
Native: In rivers, streams, and pools. Locally abundant. June to September.
I. Rotten Park Reservoir, *W. B. Grove*; pools in Sutton Park; pool near New Park; Bannersley Pool; Coleshill Pool; River Blythe, near Solihull.
II. Mill pond, Warwick, *Perry Fl.*, 36. In the Avon, Bidford Grange; in the Alne at Kinwarton! *Purt* i., 200; canal between Newbold and Harboro'! *R. S. R.*, 1877; in the Stour at Honington, *Newb.*; Salford Priors! *Rev. J. C.*

The variety *terrestre* occurs frequently with the type, and seems to be a mere form produced by local surroundings.

P. Bistorta, *Linn.* *Common Bistort.* *Snake Weed.*
Denizen; in pastures. Locally abundant. May, June.
I. In meadows at Tamworth and Fazeley, *Ray. Syn.* (3), 147; near Packington! *Aylesford, B. G.*, 685. Garlick meadows, Erdington! *With.*, ed. 7, ii., 497. Between Washwood Heath and Gravelly Hill; meadows near Solihull and Shirley; near Coleshill; near Knowle.
II. In a field at Oversley, *Purt.* i., 197; Allesley! *Bree, Mag. Nat. Hist.* iii., 164. Myton; Rowington! *Y. & B.;* Guys Cliff; Kenilworth; Balsall, *H. B.;* near Henley-in-Arden; Holywell.

THYMELACEÆ.

DAPHNE.

[*D. Mezereum*, Linn. *Spurge Olive, Dwarf Bay.*
Denizen: On rocky banks. Very rare. March.
II. Canal cutting near Shrewley Common. *H. B., Herb. Brit. Mus.*]
This plant has no claim to a place in this Flora; it was well-established in the station above mentioned at one time, but seems to be eradicated now. Probably introduced by birds dropping the seeds on these rocks.

D. Laureola, *Linn.* *Spurge Laurel.*
Native: In woods and on banks. Very local. March.
II. Oversley Wood! Grafton! *Purt.* i., 194; Newbold Comyn; Stank-hill Farm, near Warwick; Warwick Castle Mount; on the Stratford and Birmingham Roads, near Warwick! *Per. Fl.*, 36; Itchington, *Bree, Mag. Nat. Hist.* iii. 164. Near Wolstone, *R. S. R.*, 1877. Wellesbourn; Lighthorne, *Bolton King;* Lower Fullbrook; Lanes near Sherbourn; Red Hill; Drayton Bushes.

EMPETRACEÆ.

EMPETRUM.

E. nigrum, *Linn.* *Black Crowberry.*
Native: On damp heath lands. Very rare. April.
I. On marshy lands by the New Park, Middleton, *Gibson's Camden*, 516; Sutton Coldfield! *Purt.* ii., 746. Still abundant on Sutton Coldfield, but I find no trace of it near the New Park.

EUPHORBIACEÆ.

EUPHORBIA.

E. Helioscopia, *Linn.* *Sun Spurge.*
Colonist: In cultivated ground and on waste heaps. Common. March to October. Area general.

E. amygdaloides, *Linn.* *Woody Spurge.*
Native: In woods, copses, and on hedge banks. Local.
I. Bentley Park; lanes about Hockley and Earl's Wood; Shelly Coppice; Boultbie Wood, near Meriden.
II. Old Park, *Y. and B.;* Salford Priors, *Rev. J. C.;* Oversley Wood; Austey Wood, near Henley-in-Arden; Bearley Bushes; Chalcot Wood; lanes about Tanworth and Umberslade; Combe Woods.

[*E. Esula*, Linn. *Leafy branched Spurge.*
Casual: On railway banks. Very rare. June.
II. Railway banks, near Myton and Leek Wootton. *H. B.*]

E. Peplus, *Linn.* *Petty Spurge.*
Native: In cultivated land, by roadsides, and on waste heaps. Common. March to October. Area general.

E. exigua, *Linn.* *Dwarf Spurge.*
Colonist: In cornfields and on bushy roadsides. Locally common. June to November.
I. Cornfields near Sutton; Middleton; roadsides near Penns; Shustoke; Arley; Coleshill; Marston Green; Solihull; Olton; Sheldon, etc.
II. Opposite Stoneleigh Lodge; open field between Harbury and Tachbrook, *Perry Fl.*, 42; Salford Priors, *Rev. J. C.*; near Harboro' Magna; Little Lawford; Cubbington; Stoneleigh, Wilmcote; Oversley; Alcester; Ragley.
Uncertain in its occurrence, often absent for two or three seasons in any given station.
[*E. Cyparissias*, Linn., is recorded in the Rugby School Report from near Rugby, but was merely an escape.]

MERCURIALIS.

M. perennis, *Linn.* *Perennial Dog's Mercury.*
Native: In woods, copses, and shady banks. Common. February to April. Area general.
[*Buxus sempervirens*, *L.*, occurs occasionally in hedges and woods, but only where planted.]

CERATOPHYLLACEÆ.

CERATOPHYLLUM.

C. aquaticum, *E. B.* *Common Hornwort.*
Native: In pools. Rather rare.
I. Berkswell mill pool! *Herb. Perry*; pool near Berkswell Hall; pools at Springfield and Temple Balsall.
II. In a stew of the Rev. Mr. Bree's, Allesley, *Purt.* iii., 70; Chesterton Mill Pool! St. Nicholas Mill Pool, *Herb. Perry*; Caludon House Wood, near Coventry, *T. K.*, *Herb. Perry*; Old Canal, near Brown's Over, *R. S. R.*, 1868; Burton Dassett, *Y. & B.*; Itchington Holt; pool by Oakley Wood; cattle pool near Gaydon Inn; in flower, Sowe Waste Canal, 1883.

(*To be continued.*)

WEIGHING THE EARTH WITH A CHEMICAL BALANCE.

The various methods by which the density of the earth, and consequently its weight, have been ascertained, are all dependent upon the principle of comparing the pull, or attraction, of the earth upon some small body with that exerted upon the same body by some mass of definite size and weight. From reasons which are not known to us, Newton arrived at the conclusion that the earth was between 5 and 6 times as heavy as an equal sized globe of water. In 1774 Dr. Maskelyne compared the attraction of the mountain of Schiehallien, in Perthshire, upon a leaden weight suspended by a plumb-line, with the attraction of the earth for the same weight, and obtained a result for the earth's density of $4\frac{3}{4}$ times that of water. In such cases the difficulty of correctly estimating the mass of the mountain is very great. In 1854 (Sir) G. B. Airy obtained a result of $6\frac{1}{2}$ from his experiments made by swinging a pendulum at the top and at the bottom of the shaft of Harton Colliery, near South Shields. The famous experiment made by Cavendish in 1798, and repeated by Reich in 1837, and (with immense care) by Bailey in 1842, depended upon the perturbations produced in the vibrations of two small balls (fixed one at each end of a light rod suspended by a wire from its centre), when large balls of lead are brought near to the opposite sides of the small balls. The results obtained by this method vary from a little below to a little above $5\frac{1}{2}$.

The latest experiment, and that by a new method, having for its object the determination of the density of the earth, was devised and carried out by (Prof.) J. H. Poynting, in 1878, at the Owens College, Manchester. A small metal ball, weighing, say, one pound, is attached to the end of one arm of a chemical balance of very great sensitiveness, and the earth's pull upon the ball is counterbalanced with the utmost nicety by placing weights in the pan suspended from the end of the other arm. A heavy mass of metal (in the actual experiment a ball of lead weighing 340 lbs. was employed) is then placed immediately *underneath* the small ball. This small ball is then attracted both by the earth and by the large leaden mass, and its weight is consequently increased; the actual increase observed being one forty-five-millionth! Small as this quantity may seem, it was found to be quite measurable. In this way we are able to find out how strongly the small ball would be attracted by a mass of lead the size of the earth, and it is found that it would be attracted about twice as strongly as it actually is by the earth. But we know the density of lead is $11\frac{1}{4}$, therefore the density of the earth must be one-half of this, or rather more than $5\frac{1}{2}$. The precise result obtained by Prof. Poynting was 5·690. We believe that Prof. Poynting is about to repeat this very striking and original experiment, with certain modifications and improvements in small details, in a basement room (the balance must rest upon the ground to secure perfect stability) of the Mason College, Birmingham.

W. J. H.

A CALL TO PHENOLOGICAL OBSERVERS.

Dr. H. Hoffmann and Dr. E. Ihne, of Giessen, desire that all who take an interest in observing the influence of the seasons upon the vegetable world will devote themselves to ascertaining, as exactly as possible, the required particulars concerning the undermentioned plants, especially the *first flowering* and *first ripening of fruit*. The observations are to be made upon normal plants; those trained in any way (as in a garden) or exceptionally situated in a sheltered or exposed situation are to be disregarded. It is also desired that the observations may not be confined to the same plant each year, as the object is to obtain a trustworthy mean for each locality.

Feb. 10.—Corylus Avellana, *bursting of the anthers.*
Apr. 10.—Æsculus Hippocast. *f.l.*
13.—Ribes rubrum, *f.f.*
17.—R. aureum, *f.f.*
17.—Betula alba, *bursting of the anthers.*
18.—Prunus avium, *f.f.*
19.—P. spinosa, *f.f.*
19.—Betula alba, *f.l.*
22.—Prunus Cerasus, *f.f.*
23.—P. Padus, *f.f.*
23.—Pyrus communis, *f.f.*
25.—Fagus sylvatica, *f.l.*
28.—Pyrus Malus, *f.f.*
May 1.—Quercus pedunc., *f.l.*
3.—Lonicera tatarica, *f.f.*
4.—Syringa vulgaris, *f.f.*
4.—Fagus sylvat., *in full leaf.*
4.—Narcissus poeticus, *f.f.*
7.—Æsculus Hippocast., *f.f.*
9.—Cratægus Oxyacantha, *f.f.*
12.—Sarothamnus scoparius, *f.f.*
14.—Quercus pedunc., *in full leaf.*
14.—Cytisus Laburnum, *f.f.*
16.—Cydonia vulgaris, *f.f.*
16.—Sorbus aucuparia, *f.f.*
May 28.—Sambucus nigra, *f.f.*
28.—Secale cereale hib., *f.f.*
28.—Atropa Belladonna, *f.f.*
June 1.—Symphoricarpus racemosa, *f.f.*
2.—Rubus idæus, *f.f.*
2.—Salvia officinalis, *f.f.*
5.—Cornus sanguinea, *f.f.*
14.—Vitis vinifera, *f.f.*
20.—Ribes rubrum, *f.fr.*
21.—Ligustrum vulgare, *f.f.*
22.—Tilia grandifolia, *f.f.*
26.—Lonicera tatarica, *f.fr.*
30.—Lilium candidum, *f.f.*
July 4.—Rubus idæus, *f.fr.*
5.—Ribes aureum, *f.fr.*
19.—Secale cereale hib., *beginning of harvest.*
30.—Sorbus aucuparia, *f.fr.*
30.—Symphor. racem., *f.fr.*
Aug. 1.—Atropa Belladonna, *f.fr.*
11.—Sambucus nigra, *f.fr.*
24.—Cornus sanguinea, *f.fr.*
Sept. 9.—Ligustrum vulgare, *f.fr.*
16.—Æsculus Hippocast., *f.fr.*
Oct. 10.—Æsculus Hippocast., *l.d.*
13.—Betula alba, *l.d.*
15.—Fagus sylvatica, *l.d.*
20.—Quercus pedunc., *l.d.*

f.l.—First leaf fully expanded.
f.f.—First flower open.
f.fr.—First fruit ripe (in fleshy fruits).
l.d.—Leaves discoloured; more than half of the foliage changed in colour.

It is requested that observations be sent to either of the persons named, at Giessen. The dates given are the means of those observed at that town. W.B.G.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTERS V. AND VI.

"The correspondence between life and its circumstances," and "The degree of life varies as the degree of correspondence."

BY J. O. W. BARRATT, B.SC.

The proximate definition of life given in Chap. IV. does not include that adaptation which is so characteristic of living beings. Although we make use of this fact to ascertain if an animal or plant is living—as when we rouse a horse lying down in a field, or when we watch a tree to see if it puts forth leaves in spring—nevertheless, from its very commonness, we usually overlook it, paradoxical though this may appear. Supposing, however, that beings of an entirely different order to mankind were to come to this earth, the adaptation would be the first thing they would notice. They would notice it among the throng in the streets, in the houses, everywhere. And the highest manifestations of this adaptation, such as the ease with which a captain finds his way on the sea, do strike us with wonder. Again, comparing the life of a man with that of a fish, this adaptation is seen to be two-fold. Not only is the individual suited to his external world, but, not less important, the external world must be suited to the individual—a man cannot live in water, nor a fish out of it.

Thus the full conception of life of Chap. V. is arrived at. This conception has eluded the grasp of all previous generations. The late M. Comte got within measurable distance of it, but it is only within our own times that Mr. Herbert Spencer has reached it, and no one can feel any enthusiasm for Mr. Spencer unless he realises this idea.

De Blainville's definition of life is very nicely illustrated by an amœba, which might be defined as an entity in which food and oxygen were changing into waste products. In connection with these two chapters also, it is worth while calling to mind that it is by a number of amœbæ clubbing together that a compound animal, such as the fresh-water Hydra, is produced. The principle of this union is division of labour, through which the life of each cell becomes easier, and the whole animal has greater scope for action.

The differences in longevity exhibited by various forms of life sometimes appear to contradict Mr. Spencer's views of the nature of life. Thus, the average life of an oak is considered to be somewhere about 300 years, and that of a man not one hundred. But this contradiction arises through an incorrect method of estimating the average life. In the case of an oak, for instance, we must take the average life over all the seeds, whether they afterwards grow up to oaks or not. Every seed is living at the time it leaves the oak; and to tell the average life we must take all the children of the tree, and not exclude those which die in infancy. And similarly with animals. If this were done, we may infer that the average life would be found to be longer the higher it is.

A VISIT TO CEYLON.*

At first sight one would perhaps expect to find a new work from the distinguished Evolutionist who has so ably extended the Darwinian theory in his "Histories of Creation and the Evolution of Man" to be an abstruse and somewhat technical treatise. Nothing of the kind. This is one of the most delightful and readable books on natural history and travel that has appeared in these days. Like our own lamented, versatile, and enthusiastic Charles Kingsley, who ever cherished a desire to behold the Tropics and "at last" was gratified, so Professor Ernst Haeckel from boyhood seems to have had a similar longing, which in its turn was fulfilled. He says:—"That every naturalist who has made it his life-task to study the forms of organic life on the earth should desire to see for himself all the marvels of tropical nature is self-evident; it must be one of his dearest wishes. For it is only between the Tropics, and under the stimulating influence of a brighter sun and greater heat that the animal and vegetable life on our globe reach that highest and most marvellous variety of form, compared to which the fauna and flora of our temperate zone appear but a pale and feeble phantom."

As the learned Professor's journey was for the benefit of science, one would have thought that his fellow countrymen, one and all, would have aided him, where opportunity presented, to the best of their ability. But, alas, in this he found, as too many have done before, that "a prophet is never without honour save in his own country." It appears that the Academy of Sciences at Berlin, the most important institution of its kind in Germany, has the income or "travelling allowance" arising out of the Humboldt Fund at its disposal. At the suggestion of friends, and as he had achieved all his scientific excursions during a quarter of a century at his own cost, he applied to the Academy for a grant in aid of his expedition to Ceylon. But it seems that the leading spirits of the Academy are "the most vehement opponents of the doctrine of

* A Visit to Ceylon: By Ernst Haeckel, Professor in the University of Jena Translated by Clara Bell. London: Kegan Paul, Trench, and Co., 1883.

evolution, while the Professor for many years had been deeply interested in its advancement and development." The result was that the application was simply refused! However, he had warm sympathy and encouragement from many naturalists and other friends both in Germany and England, including in the latter the late Charles Darwin (to whom, as his "honoured friend and master," he subsequently wrote a letter of congratulation on his 73rd birthday from Adam's Peak, the highest mountain in Ceylon), and the late Sir Wyville Thomson, of H.M.S. "Challenger."

Abundantly provided with books of reference, microscope, scientific apparatus for physical observations and for photographing, together with trawling and dredging and surface nets, a double-barrelled gun, sketching and painting materials, and an almost endless variety of bottles, phials, tin cases, and preserving fluids, the whole stowed away in sixteen trunks and cases, he left his home on the 8th October, 1881, and journeyed to Ceylon from Trieste, *viâ* Egypt, to Bombay, by the Austrian Lloyd's steamer "Helios" (a most significant name, *Nomen sit omen!*) and returned, *viâ* Cairo, on the 21st April following. He was, therefore, absent upwards of six months. He landed at Bombay on the 8th November, and he speaks of it as "The glorious and memorable day in his life when he first set foot in a tropical land, admired tropical vegetation, and gazed in astonishment at tropical life in man and beast." During a brief week at Bombay he chronicles his first impressions of tropical life and its environment in the vicinity. Bombay he compares to Naples, in regard to its magnificent situation on a deeply indented and hilly coast, beautified by a glorious vegetation, and its chain of islands and rocks enclosing the wide and splendid bay. After reference generally to the population of Bombay (numbering, in 1872, 650,000 souls), he proceeds to describe the most remarkable and important element—the Parsis or Guebres—numbering about 50,000, descended from the ancient Persians—the men of tall and stalwart figures, with yellow olive faces—who by their indefatigable energy, prudence, industry, generosity and public spirit have gained much influence and play an important part. Some have been raised to the dignity of baronets by the English Government in recognition of their merits. The funeral ceremonies of this people are most remarkable. High up on the ridge of the Malabar Hill is their cemetery, in which stand the six Dokhamas or "Towers of Silence"—cylindrical white towers, 40ft. in diameter and the same in height. The inside is divided into three concentric circles with separate open divisions. The dead are here exposed, the men in the outer circle, the women in the next, and the children in the inner, where they are consumed—except the bones, which are collected—by the sacred bird of Ormuz, the fine brown vulture, and by black ravens.

An excursion to the Palm Grove of Mahim—the first he had seen—next claimed his attention. Here "toddy gatherers" climbed the trunks with the agility of apes to collect the palm sap, others were busy gathering the fruit of the Banana. He could never tire of admiring the magnificent effects of light produced by the play of the sunbeams on the broad quivering feathery leaves of the cocoa nut palms and on their white gracefully-bent trunks, as well as on the tender pale green leaves of enormous size. He captured an enormous spider with a thick body, 2¼in. long, and thin legs, 4in. long. On the sandy shore numbers of zoological surprises awaited him, left here by a low tide, enormous specimens of a splendid blue Medusa—a species of *Crambessa*, more than a foot across—a curious sea urchin, *Diodon*—with a thorny coat and its laryngeal sack blown out to a large size—large *Serpulæ*, numerous crustacea—notably the swift-footed sand crabs, that make pits in the sand, and fragments of skeletons of fish, and human skeletons, skulls, &c.

But we must no longer linger at Bombay; a pleasant voyage of five days brought the Professor from Bombay to Colombo. He says, "it was on the 21st November, in the glorious light of a cloudless tropical morning that I first set foot on that ever-green island of marvels, Ceylon, where I was about to spend the most instructive and delightful months of my life." He landed at Colombo by means of the curious native boat composed of a tree trunk, 20ft. long, and hollowed out, the width being only about 18in. It appears that although Galle has the finer harbour, Colombo is preferred, on account of its being the chief town, and most of the shipping interest is centered here. The climate is one of the hottest in the world, and the country round is flat. The principal streets of the town are decorated with shady avenues of a fine Mallow, *Hibiscus*; the large yellow or red blossoms strew the earth in every direction. He speaks enthusiastically of "the astounding marvels of its magnificent vegetation: palms and Pisang, *Pandanus* and *Lianas*, tree ferns, banyans, &c.;" and of its no less interesting zoological treasures: apes, dappled Axis deer, parrots, and gorgeously coloured pigeons."

He remained for the first two weeks enjoying "the hearty and home-like hospitality" of his countryman, Herr Stipperger, at "Whist Bungalow," about three miles from the fort. This charming place owes its eccentric name to the fact that a former owner, an old English officer, used to invite his friends to play whist with him there on Sundays! During the ride there, through Pettah, scenes of tropical life passed before his astonished eyes, "as changing pictures in a magic lantern!" All the mixed and motley population of every type characteristic of Colombo was out of doors, collected in knots in front of the little houses, or enjoying the shade of the cocoa nut trees. Most of the life and labour of the natives is carried on in public. The particular charm is "naive publicity and primitive simplicity." Nature is so beneficent here that the little garden plots enclosing the native hovels constitute the chief income and sustenance of the people. Above all natural products must be placed the invaluable cocoa-nut palm, "every part of which has its use," often constituting the whole fortune of a Cinghalese. The number of cocoa-nut palms in the island is estimated at forty millions, each producing from eighty to a hundred nuts, yielding eight to ten quarts of oil. From 60ft. to 80ft. in height, with white stem and a dense crown of immense pinnate leaves, it must indeed be a gorgeous object. Next in value come the Palmyra palm, the Areca palm, and the Kitool. After these the bread fruit and the mango trees, the figs of Paradise and the Aroids. He contrasts the lovely green of these trees with the bright red colour of the soil, largely impregnated with oxide of iron. "In perfect harmony, too, are the cinnamon-hued Cinghalese themselves, and the blackish-brown Tamils." The delightful situation of Whist Bungalow charmed him—commanding a view of the sea, the mouth of the river, and the beautiful island in its delta. But the chief attraction of the place was its garden, which, under "the careful and loving hand of its owner, had become one of the most enchanting spots in the Paradise of Ceylon," containing specimens of almost every important plant characteristic of the flora of the islands—a perfect Botanic garden.

From here he passed to Kaduwella, a Cinghalese village about ten miles from Whist Bungalow. Here he describes native life and the "most delightful feature of insensible transition from garden to forest land, from culture to the wilderness." Next were visited Peradenia, where are the botanic gardens, and where he met the accomplished Director, Dr. Trimen, and Dr. Marshall Ward, the "Royal Cryptogamist," who was sent out to Ceylon to investigate the terrible coffee leaf disease, a fungus *(Hemileja vastatrix)*, resembling rust in corn.

He then visited Galle (from *Galla*, Cinghalese for rocks), the most famous and important town of Ceylon from a very remote antiquity. In the opinion of the Professor the Tarshish of the ancient Phœnicians and Hebrews can only have been Galle; the apes and peacocks, ivory and gold which those navigators brought from the legendary Tarshish, were actually know to the old Hebrew writers by the same names as they now bear amon the Tamils of Ceylon, and all the descriptions of the much-frequented part of Tarshish apply to none of the seaports of the Island but the Rock Point—Punto Galla." We must not stay long with him while he revels in its glorious situation, its refreshing sea breezes, its pretty hill country, and the Villa Marina of Captain Bayley, "an enterprising and many-sided man" with whom he stayed. The fern gardens, with native tree ferns, Selaginellæ, and Lycopodia, the orchids, Begoniæ, Bromeliæ, &c., were all attractions. Here, also, there was a private menagerie with rare Mammalia and birds, and an indigenous ant-eater, *(Manis)*. But most attractive were the magnificent corals on the surrounding rocks, and a small inlet of the sea used as a dock for the captain's boat abounded with those, with huge black "sea urchins and red starfish, numbers of crustaceans and fishes, brightly-coloured mollusca, and strange worms!" He contrasts the colours of the corals of the Arabian Gulf, which he visited in 1873—yellow, orange, red, and brown, with the prevailing green colour of the Ceylon corals—yellow green, sea green—Malachite and brown-green. It is noteworthy that this colour (green) predominates in the island, both in the vegetable and animal kingdoms, and is explained on Darwin's principles "in the law of adaptation by selection of similar colouring or sympathet affinity of colour," and has been elucidated by Professor Ernst Haeckel in the "History of Creation."

We reluctantly pass over much interesting matter in order to accompany the Professor in his visit to Belligam (Cinghalese *Veligama*, —sand village, but for which by a graceful fancy he not inappropriately gives a new derivation *Bella gemma*—lovely gem, because in his recollection it was "A choice jewel in nature's casket.") Here by the sea in the "Rest-house" (a kind of Government hotel) he established his zoological laboratory and dwelt six weeks among the Cinghalese. He records the kind services rendered by the "shrewd old Rest-house keeper," whom he named "Socrates," and the devoted attentions of the gentle Pariah boy, whom he named "Ganymede." The village is very beautiful, situated in the midst of cocoa woods, and the sheltered bay is rich in corals. Notwithstanding the difficulties attending the study of marine zoology in the Tropics, with the temperature from 86° to 90° Far. in the shade, and with the atmosphere so humid that the skins of birds and mammals shot and prepared with pains and hung in the sun every day for weeks were always thoroughly wetted through again every night, with an absence of glass windows to his laboratory, which was consequently open to every flying and creeping creature, and without a single assistant except the Cinghalese, the Professor secured and studied many new and interesting forms of Marine life. He speaks of the elegant *Medusæ* and beautiful *Siphonophora*, *Salpæ*, *Hyaleadæ*, and other Pteropoda, larvæ of Mollusca and lovely Polyps and Corals. The difficulties of examining living specimens were immense, for specimens which in his previous experience in the Mediterranean did not decompose until after five to ten hours, had begun to do so at Belligam in half an hour.

After Belligam came excursions to Basamuna point—Mirissa headland—Kogalla Veva, the rocky lake—Boralu Veva, the pebble lake, Dondera head, or thunder cape, the town of Matura on the Nilwella Ganga, the blue sand river, all of which added to his knowledge and pleasure. The learned Professor devoted the last month of his stay in Ceylon to a visit to the coffee district and hill country. In the coffee district this once famous trade had succumbed from its maximum between 1845 and 1850 from over speculation and from dangerous natural foes, "The greedy Golunda rat (*Golunda Elliotti*) the mischievous coffee bug (*Lecanium coffeæ*), and the worst foe of all, the microscopic fungus (*Hemileja vastatrix*). Tea and quinine (*Cinchona* bark) have, however, taken its place with great success." At Newera Ellia (pronounced Nurellia), "a remote and dismal spot" in the hill country, the town stands in an elliptical mountain valley, with a range of mountains 1,500ft. to 2,000ft. high. It is used as a sanitarium or health-resort by the Europeans, but, according to the Professor, its excessive dampness, with cold, frosty nights and hot days—the temperature at noon being often 86°—are great natural obstacles to its success in this respect, and he "considers its merits monstrously over-rated." Nevertheless, it is a fashionable resort for the European residents, with the accompanying evils of high prices and bad accommodation! The most remarkable objects seen near here were a gigantic worm, 5ft. long, an inch thick, and of a fine sky-blue colour; the beautiful mountain jungle fowl (*Gallus Lafayetti*); and the large ash-coloured monkey of the hill forests (*Presbytes ursinus*).

At the lonely northern portion of the Island—the home of leopards, bears, and wild elephants—called Horton's Plain—is a precipice known by the characteristic name of "The World's End. The rocky wall here terminates in an abrupt fall of 5,000ft.; the view of the southern rich plain below from the top is described as grand. Here the Professor and his native attendants wandered in the tracks of wild elephants—the only paths—and on one occasion only he saw a herd of "ten or twelve elephants taking their breakfast very much at their ease." Here, also, he ascended Adam's Peak 7,200ft. high, and took his leave for ever of the hill country of Ceylon," returning to Colombo partly by the Black River, near which "the tropical vegetation seems to have reached its richest development." The troublesome land leeches of Ceylon were the only *contretemps*.

An uneventful journey to Egypt by the "Castor" *en route* for home succeeded. At Cairo he remained a few days, and had an opportunity of observing the contrast not only between "the noisy and eager Arab" and "the gentle unpresuming Cinghalese," but also between the vegetation of fertile Ceylon and arid Egypt. He points out the "botanical symbols" peculiar to each country—the palm, represented in Ceylon by the cocoa-nut and in Egypt by the date-palm, "each of almost equal value," but totally dissimilar in appearance and effect—each being appropriate in its own environment. A high compliment to British colonisation concludes this beautiful and remarkable book, which should be read by every naturalist, and by everyone seeking to be acquainted with the present condition of Ceylon.

We shall look forward pleasurably to further accounts of this most interesting expedition, and of the rich and varied collections in Natural History made by the Professor. The volume has been translated from the German by Clara Bell, and that lady appears to have accomplished the task in a genial spirit and most successfully. There is little to indicate that it is other than an original work.

In our humble opinion it is more than a mere coincidence that the writings of the Evolutionists—Darwin, Fiske, Haeckel, Huxley, Lyell, Herbert Spencer, Tyndall, *et id genus omne*—of which this is a notable example—rank among the most brilliant and remarkable specimens that have characterised a generation unusually rich in literature of all kinds. It is a product of the great and all embracing doctrine which they advocate.

W. R. Hughes.

METEOROLOGICAL NOTES.—April, 1884.

The barometer was rather low at the commencement of the month, and fell till the 5th, after which it rose steadily till the 14th; two slight depressions were succeeded by a gradual fall to the end of the month. Temperature was rather high for the first few days, but after the 9th it remained low, with air-frosts from the 20th to the 25th. The minimum on the 23rd was the lowest recorded since November: 21.5° being registered at Coston Rectory, 23.6° at Hodsock, 25.0° at Loughborough, and 26.7° at Strelley, where the thermometer on the grass fell to 18.3°. These low temperatures were very injurious to the fruit crops, especially that of the 23rd, following a slight fall of rain. The highest temperatures recorded were lower than those of March. Maxima were registered as follows:—On the 3rd, Loughborough, 66.2°; Hodsock, 64.9°; Strelley, 64.1°; and on the 2nd, Coston Rectory, 64.8°. Rainfall was slightly above the average, but less than two inches in the aggregate, and was fairly distributed through the month. Sunshine was below the average. Lightning was seen at Loughborough on the evening of the 2nd. Thunder was heard at Hodsock on the 28th, accompanied by a sharp hailstorm. Aurora was seen on the evening of the 24th. Northern winds, of moderate force, prevailed from the 7th. The cuckoo was heard in various places before the end of the month.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street, Loughborough.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Seventh Annual Meeting will be held at Peterborough on Wednesday and Thursday, the 25th and 26th of June instant.

PROGRAMME FOR WEDNESDAY.

The Council will meet at 12-45.

The Annual Meeting will be held in the Fitzwilliam Hall, Peterborough (kindly lent for the occasion by Mr. Alderman Nichols), on Wednesday, June 25th, at three o'clock, the President of the Union (the Very Rev. the Dean of Peterborough) in the chair. The President will open the meeting with an address.

Reception Room.—A Reception Room will be provided at the School of Art, in the Minster Close, for Members of the Union and other Visitors, and letters may be addressed there. An Arrival Book will lie on the table, and it is hoped that all Visitors will enter their names and temporary addresses in it, for the information of friends who may desire to communicate with them. The same room will also serve as a News Room, and will be supplied with newspapers.

Conversazione.—A Conversazione will be held in the Fitzwilliam Hall on Wednesday Evening, June 25th. There will be an exhibition of objects of general scientific interest, Microscopy, the various departments of Natural History, Art, and Archæology, especially of Relics from the Fenland and of Saxon and Roman Remains from Castor (the Durobrivæ of Antoninus) and the neighbourhood. Members of Societies in the Union and Friends willing to contribute specimens, or to exhibit or lend microscopes, will oblige by at once communicating with Mr. J. W. Bodger, 18, Cowgate, Peterborough. During the evening short Addresses will be delivered by the Rev. Canon Ayles;

Dr. T. J. Walker, on the Roman Remains of the Neighbourhood; and by W. J. Harrison, Esq., F.G.S., on the Ice Age and the Stone Age. At intervals, a selection of Instrumental Music will be performed under the directorship of the Rev. F. Wilkinson. The charge of admission to the Conversazione will be Two Shillings. Doors open at half-past Seven. Morning Dress. Carriages may be ordered for half-past Ten. Tickets are now ready, and can be obtained by Members for themselves, and for friends not Members of the Union, through any of the Secretaries of the Societies in the Union, or direct from Mr. J. W. Bodger, 18, Cowgate, Peterborough. On Wednesday Afternoon, June 25th, immediately after the Annual Meeting, a party will visit the Cathedral. A Botanical Excursion will be made to Thorpe Hall (by kind permission of E. J. Strong, Esq.) and Holywell, returning by the River Nene. A Geological Excursion will be made to the large sections of Oxford Clay exhibited in the brick fields, and to the Fluvio-marine Gravels, both at Woodstone and Fletton.

Luncheon.—A Luncheon will be provided on Wednesday, June 25th, at 2 o'clock, for the Council, Members of the Union, and Visitors. Tickets, price 2s. 6d. each, to be obtained from Mr. J. W. Bodger, 18, Cowgate, Peterborough. Early application should be made for these tickets, so that sufficient accommodation may be provided.

PROGRAMME FOR THURSDAY.

Excursions.—On Thursday, June 26th, there will be two Excursions, viz.: an Upland Excursion to Stibbington Hall and the Bedford Purlieus, and the other to the Fenland.

The Upland party will leave Peterborough about Nine o'clock, and will proceed to Chesterton and to Stibbington Hall, Wansford, and Bedford Purlieus; lunch will be served here. The return journey will be by Sutton Marsh, through Milton to Peterborough, where a Meat Tea will be provided. Tickets for this Excursion: Nine Shillings and Sixpence each, including Carriage Drive, Luncheon, and Meat Tea.

The Fenland party will leave Peterborough about Nine o'clock, and will proceed to the Decoy in Borough Fen, thence to Croyland Abbey, where lunch will be served at the Hotel, after which the Party will proceed to Thorney Abbey, thence to Peterborough, where a Meat Tea will be provided. Tickets for this Excursion: Eight Shillings and Sixpence each, including Carriage Drive, Luncheon, and Meat Tea.

Tickets must be applied for not later than Saturday, June 21st, and may be procured from Mr. J. W. Bodger, 18, Cowgate, Peterborough.

Mr. Herbert Spencer.—The *Athenæum* of May 17th states that China appears to be beginning to adopt the idea of Western civilisation, for a translation of Mr. Herbert Spencer's "Education" has just reached this country. The translator, Y. K. Yen, says in his English preface, "Believing that it will aid in reforming the present narrow education in my country, and thus be the means of promoting her progress," he has translated the first of his essays. Mr. Herbert Spencer's "Education" has been translated into every living language in Europe, into Japanese and Chinese, and it is believed into several of the vernacular languages of India.

Review.

Beiträge zur Phänologie. By EGON IHNE and HERMANN HOFFMANN. 178 pp. Giessen, 1884.

THIS pamphlet consists of two parts, the first giving a history of phenological observations in Europe and a list of the magazines and other publications in which they are enshrined, compiled by Dr. E. Ihne; the second a number of unpublished phenological observations during the years 1879-82, from various parts of Europe, arranged by Dr. H. Hoffmann, Professor of Botany at Giessen. Dr. Ihne undertook the enormous task of compiling this history in preparation for the work which he intends to perform of publishing a series of phenological maps of Europe, each devoted to a single plant. He expects that the first of the series, relating to *Syringa vulgaris*, will appear during the present year. He gives not only a list of various publications in which observations of this kind on flowering plants and mosses are contained, with, in many cases, details to show their usefulness and extent, but also lists of the stations at which these observations were made, classified (1) alphabetically and (2) according to countries. From this it is manifest that an enormous body of trustworthy observations now exists, extending over more than a hundred years, and over nearly the whole of Europe. The only country which has not contributed to the total is Turkey; Greece and Montenegro come next with one station each, then Denmark, Portugal, and Spain. Great Britain occupies a most honourable place, being surpassed only by Germany and Austro-Hungary (which are combined in one total). The "Midland Naturalist" is duly quoted for the records which appeared therein from 1879 to 1882.

The second part, by Dr. Hoffmann, contains a scheme for phenological observations, which it would be best for English observers to adopt, as by that means their records will be capable of easy comparison with those of Continental observers. This is presented on another page. Dr. Hoffmann has invented a method of calculation which enables him to check published records with great ease. He chooses Giessen as the standard, as not only is it situated towards the middle of Europe, but it possesses the longest and most extensive series of phenological observations made by one man, namely himself, as a sure basis for comparison. He then calculates the average time of, *e.g.*, the flowering of various trees at Giessen, and with them compares the average times so calculated for some other place. It will be found that, if the data are equally correct, in each case the average retardation or acceleration of blooming in any one month will be nearly the same for all the plants compared. Thus St. Paul is three days later than Giessen, on the basis of eight April-blooming plants; St. Petersburg, forty-two days later; Vienna, eight days earlier; while Edinburgh is doubtfully given as thirty-six days later. What Dr. Hoffmann wishes, in order to carry out his plan, is a series observations made at the same place by the same observers on the same species of plants. W.B.G.

Natural History Notes.

ARRIVAL OF SWALLOWS.—On Sunday evening, May 11th, at 7.45, a large flock of swallows ("Martins?") quite 1.000 in number arrived from beyond the seas, and flew over my head. I was standing by Oulton Broad (Mutford Bridge). They tell me there that such a thing is seldom seen, indeed that only *one* arrival of that magnitude is recorded. As a rule they appear by *twos* and *threes* in the morning, *i.e.*, on the water, etc. I suppose these birds left too early and made land sooner than they intended; they were in a great hurry and twittering most vigorously.—EGBERT DE HAMEL.

MR. CHAS. KETLEY.—We regret to have to record the death of Mr. Chas. Ketley, of Smethwick, which took place on the 22nd April last, in the 66th year of his age. He had occupied for more than 40 years a responsible position in the local establishment of Messrs. Pickford and Co., and the respect shown by the firm and his colleagues on the occasion of his funeral showed the high esteem in which he was held by them all. As his occupation for many years consisted in the management of the Dudley business of the firm, his attention was early attracted by the beauty and variety of the limestone fossils for which this classic spot is so celebrated, and he soon formed a collection of the choicest specimens, in the selection of which he brought to bear an amount of scientific knowledge which enabled him to understand and appreciate those specimens which best exhibited organic structure and variety. The late Mr. J. W. Salter and M. De Koninck both expressed the highest pleasure in going through Mr. Ketley's collection, and several of his specimens are figured and described in Mr. Salter's unfinished monograph of the Trilobites, published by the Palæontographical Society. It was a delightful occupation to spend a few hours now and then with him and go through his cabinet, listening to his explanations, while he pointed out the particular merits of each specimen, for each one was the most perfect he could obtain. The Dudley and Midland Geological Society purchased a fine collection of Crinoidea from him some years ago, and a year or two since he disposed of his whole remaining collection to the Mason College, Birmingham. His unobtrusive manners and failing health caused him not to be so well known among local scientific societies of late years, but he was one of the earliest members both of the Birmingham Microscopical and Natural History Society and of the Dudley and Midland Geological Society, and though he was unable to attend their meetings, there was little that was done in which he did not take an ardent interest. We feel that by his removal we have lost a scientific *collaborateur* of no mean intelligence, whilst those who enjoyed the privilege of his intimacy mourn the loss of a generous true-hearted friend.—W. M.

FLORA OF OXFORDSHIRE.—The *Athenæum* announces that Mr. G. Claridge Druce, F.L.S., is preparing a "Flora of Oxfordshire." The Flora is intended to be not only a catalogue, but a history of Oxfordshire plants, and of the botanists connected with the University and County. The botanical divisions of the county will be based on the river drainage, the old authors from 1550 downwards will be freely quoted, and the herbaria at the Oxford Garden, the British Museum, &c., and in the possession of private individuals, will also be consulted. With the Flora will also be incorporated the large number of MS. notes left by the late Alfred French, of the British Museum, and the previously unpublished notes of Mr. W. H. Baxter, of the Oxford

Botanic Garden. and much assistance will also be given by the Rev. W. W. Newbould, M.A., Rev. A. Robertson, M.A., of Hatfield Hall; T. Beesley, Esq., of Banbury; Bolton King, Esq., of Balliol; F. T. Richards, Esq., M.A., Trinity; H. M. Ridley, Esq., British Museum; the Lord Selborne, Rev. W. Marshall, Rev. F. W. Bennett, H. E. Garnsey, M.A., Magdalen College; H. Boswell Esq., Rev. E. Fox, &c.

Ornithological Notes.—The cold east winds that prevailed during the month of April seem to have retarded the arrival of many of our migratory birds, but some of the later ones were true to their time. On the 29th March I noticed both the Chiffchaff and the Willow Wren about the hedges. The local paper announced the arrival of the Sand Martin at Shrewsbury as early as April 2nd, but time prevented me going as far to see them; however, I kept a bright look-out in the neighbourhood, but failed to see anything of them. Rooks were still building and fighting on the 6th. On the 13th I went down to Folkestone for a fortnight, and during the whole time I was there the wind was in the east, and it was not warm. On the 16th I found a Hedge Sparrow's nest and a Blackbird's nest, each containing three eggs; I also saw a few Plovers' eggs in the market. On the 19th I went for a ramble over Romney Marshes, and on my way I saw, for the first time, large numbers of Sand Martins and Swallows flying about the military canal. On the marshes I saw a pair of grey Wagtails, a Heron, a Kestrel, and a large flock of Gulls; principally lesser Blackbacks, but a few Herring Gulls and Kittiwakes. At Saltwood Castle, on the 20th, I observed a pair of Wrynecks, and on my way home I heard the Cuckoo at last. The peculiar double cry of the Cuckoo was once a subject of discussion in an early volume of this magazine. It is very common, and scarcely a day passes without my hearing it. Two years ago I heard a Cuckoo stop short in the middle of its note, and begin again after a slight pause (cuckoo-cuck-cuckoo, &c.) On one occasion I heard this seventeen times in quick succession. I could find no cause for it, and now I can't find a bird that does not do it. It is far more frequent than the ordinary double cry. On May 19th, this year, I heard a bird double the last syllable of its note five times (cuckoo-koo). This is a variety I have never heard, either before or since. On May 11th and 17th I heard the Cuckoo's note not only doubled but quadrupled. At the end of April the weather became much warmer, and on the 28th I returned to this part of the country. On the 29th I first saw the House Martin, but it must have arrived some time previously. I also saw a number of Whitethroats, and late in the evening I heard the Corncrake frequently. May 3rd was Saturday, and so I had my usual long walk in the country. I saw a few Lesser Whitethroats and the Garden and Sedge Warblers. On the 4th I saw two or three Swifts flying about, and on the 6th there were numbers of them to be seen. I heard young Rooks cawing in the rookery near the town. On the 10th I saw a pair of Sandpipers on the banks of the canal. On May 11th I saw a Turtle Dove, and on the main road I saw three Wagtails together, and noticed that they all varied in colour—black, dark, and light-grey on the back. On the 13th a friend of mine told me there were some Nightingales to be heard in a coppice, known as Loam Hole, at Coalbrookdale, about six miles from here. He also told me that they were at the same place last year. The next Saturday (17th) I went my usual walk with the intention of getting to Coalbrookdale at 10 P.M. The bird was singing, or, rather, calling to its mate when I arrived, and I sat on a gate and listened to it for an hour and a half. When I went away I still doubted that it really was a Nightingale, and determined to come again in the daytime and see it. Accordingly I went last Thursday, and arrived at the coppice at 7 P.M. I had not been there long before I was confronted by the keeper, but I made friends with him, and he told me that the birds I was in search of were really Nightingales, and that they had frequented the place for years. At present there were five of them. I remained in the coppice two hours, but I was under supervision, and about 8 o'clock the birds began to sing. With the aid of my glass I searched high and low for the birds, and after nearly an hour's search I saw two of them on the young saplings that abounded there. It was too dark to identify them, but they seemed to me to be about the size of a Yellowhammer. I intend going again till I have identified them. On the 17th instant I noticed several Wood Warblers on the Wrekin, and on the 23rd I discovered, on one of the beams of a shed on a friend's farm, a Blackbird's nest. I was told it had been robbed, but on carelessly taking it down to look at it I was surprised to find that a Redstart had built its own nest inside and laid seven eggs. Both nests and eggs are now in my possession.—T. V. HODGSON, Admaston, Wellington, Salop.

BOTANICAL NOTES FROM SOUTH BEDS,
WITH VOUCHER SPECIMENS.

NAME.	DATE, 1884.	ASPECT.	SITUATION, &c.
Potentilla Fragariastrum.	Jan. 6.	—	Coppice.
Anthriscus sylvestris.....	,, 10.	S.	Hedge bank, Herts.
Taraxacum Dens-leonis.	,, 12.	Open.	Meadow.
Tussilago Farfara	,, 12.	S.	Railway bank. One flower.
Corylus Avellana........	,, 13.	—	Coppice.
Mercurialis perennis.....	,, 13.	—	Coppice.
Erophila verna..........	Feb. 17.	Open.	Fallow field.
Cardamine hirsuta.......	Mar. 6.	W.	Side of a stream. In fruit.
Ranunculus Ficaria......	,, 6.	W.	Moist bank.
Primula veris...........	,, 9.	W.	Pasture.
Prunus spinosa..........	,, 16.	—	Hedge.
Anemone nemorosa......	,, 16.	—	Coppice.
Stellaria Holostea.......	,, 23.	—	Hedge bank.
Nepeta Glechoma	,, 23.	S.	Hedge bank, Herts.
,, ,,	,, 29.	S.	Hedge bank, Beds.
Ranunculus acris........	,, 29.	S.	Riverside. One flower only.
Caltha palustris.........	,, 29.	Open.	Moist meadow.
Luzula campestris.......	,, 30.	,,	Pasture.
Cardamine pratensis.....	April 5.	,,	Moist meadow.
Equisetum arvense......	,, 5.	,,	Moist meadow.
Scilla nutans............	,, 6.	—	Spinney.
Geranium Robertianum..	,, 10.	S.	Hedge bank.
Ranunculus auricomus...	,, 10.	—	Spinney.
Sisymbrium Alliaria.....	,, 19.	W.	Hedge bank.
Orchis mascula..........	May 4.	—	Coppice (plentiful).
Viburnum Lantana......	,, 10.	Open.	Hedge.
Cratægus monogyna.....	,, 11.	Open.	Hedge.
Saxifraga granulata......	,, 11.	S.	Pasture.
Valeriana dioica.........	,, 11.	Open.	Meadow.

The cuckoo was heard April 17th, and the nightingale April 28th.
J. SAUNDERS, Luton.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, May 6th.—Mr. W. B. Grove exhibited Fungi, all from this neighbourhood:—*Puccinia anemones*, *Phragmidium mucronatum*, *P. obtusatum*, *Œcidium Ficariæ*, *Œ. Lapsanæ*, *Peziza tuberosa*, *Sphæria acuminata*, *S. pulvis-pyrius*, *S. herbarum*, *Helminthosporium rhopaloides* (very rare), *Bispora monilioides*, *Dinemasporium hispidulum*, *Polyactis fascicularis*, *Leptostroma juncinum*. Mr. J. E. Bagnall exhibited *Taraxacum palustre*, *T. lævigatum* (rare), from near Barston, and other flowering plants, and the following Mosses: *Tortula papillosa*, *T. latifolia*, *T. insulana*, *Orthotrichum affine*, *Scleropodium cæspitosum*, *Brachythecium rivulare*, the latter new to Warwickshire, and the others from Henfield and Barston; he also exhibited microscopical preparations to show fasciated seta in *Fissidens tamarindifolius*, a rare phenomenon in mosses, and several peristomes. Mr. T. Bolton exhibited living and mounted specimens of *Leptodora hyalina* in the nauplius stage; a cluster of a very minute Actinophrys-like Rhizopod, and the Prothallus of an Equisetum.—Biological Section, May 13th:—Exhibited by Mr. R. W. Chase, eggs in clutches of the following birds: *Aquila chrysaëtos*, golden eagle, near Stornoway; *Buteo vulgaris*, common buzzard, near Towyn; *Falco peregrinus*, peregrine falcon, near Towyn; *Querquedula circia*, Garganey teal, Norfolk. By Mr. T. Bolton, *Leptodora hyalina* in an early stage of its development; *Anuræa longispina*, one of the rotifers, and *Ceratium longicorne*, an infusorian allied to *Leptodora*. By Mr. Charles Pumphrey, the protecting hairs in the throat of the Pansy, and the glandular hairs of the London Pride, *Saxifraga umbrosa*. By Mr. J. E. Bagnall, *Prunus Padus*, the bird cherry; Mosses, *Brachythecium rivulare*; *Dichodontium pellucidum*, *Dicranum majus*; *Amblystegium irriguum* in fruit, *Sphagnum auriculatum*; Hepatics, *Lepidozia reptans*, *Kantia Trichomanes* in fruit; Lichens, *Usnea hirta*, *Parmelia caperata*, and many other rare mosses and lichens; also microscopical preparations to show the more minute structure of these plants. Microscopical General Meeting, May 20th.—Mr. J. E. Bagnall exhibited *Orchis morio*, *Melica uniflora*, and *Veronica montana*, from near Hurley; he also exhibited on behalf of Professor Hillhouse, a section of the pistil of *Œnothera* showing the pollen and pollen-tubes. Mr. W. B. Grove exhibited *Chætostylum Fresenii*, from Malvern, a fungus new to Great Britain; *Puccinia convolvuli*, from North America; *P. pilocarpi*, from South America; *Trichobasis petroselini* and *Omphalia stellata*, from Crieff. Mr. T. Bolton exhibited mounted specimens of *Leptodora hyalina*, showing the persistent nauplius eye, the first time this has been exhibited in England in this stage; *Argulus foliaceus* in one of the early larval stages, and specimens of Rotifers, Brachionus, Anuræa, &c., several showing parasites. Mr. J. Levick exhibited *Melicerta ringens*. Mr. J. Blakemore exhibited *Actinophrys Eichhornii*. There was also exhibited on behalf of Mr. C. Caswell a specimen of the Arum Lily (*Calla æthiopica*), with three flowers (spathes) on one stem.—Sociological Section, May 22nd.—The study of Mr. Herbert Spencer's Principles of Biology was continued, chapters 5 and 6 of Part II., on "Adaptation" and "Individuality," being introduced by Dr. Heipe.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 21st, Microscopical and General Meeting.—Mr. C. P.

Neville exhibited a collection of shells, zoophytes, &c., from the Blackpool district. Mr. Madison, various specimens of lead ore from Matlock. Under the microscopes the following objects were exhibited: By Mr. Taylor, a section of Carboniferous Limestone, showing Foraminifera *in situ;* Mr. Insley, a section of Diorite, by polar light; Mr. Moore, gizzard of *Pediculus capitis;* Mr. Dunn, Spineless Water Flea, *Daphnia vetula.* April 26th.—An excursion was made to Rowley Regis, where the members were met at the station by Mr. Beale, who conducted them through a quarry, pointing out the striæ on numerous blocks resulting from ice action; also many other interesting features connected with the Basalt. The party then adjourned to inspect Mr. Beale's fine geological collection, after which a vote of thanks to that gentleman for his kindly proffered services as guide brought a pleasant afternoon to a close. April 28th.—Mr. J. B. Stone, J.P., presented to the Society (through Mr. Flower) a copy of his new book, "Children in Norway; or, a Holiday on the Ekeberg." Mr. Insley exhibited various specimens of Basalt from Rowley Regis; Mr. Tylar, two photographs of the party in the quarry; Mr. Darley, larvæ of Wood Tiger Moth; Mr. Hawkes, an album of dried plants from Kingswood, collected in a day's ramble; Mr. Madison, shells of *Helix pomatia, H. lapicida,* and *Cyclostoma elegans,* with models of their inmates, giving them a life-like appearance; also models of *Limax flavus* and *Arion ater.* Under the microscopes Mr. Hawkes showed Batrachospermum and *Closterium Lunula;* Mr. Tylar, sting of Scorpion. A paper was then read by Mr. J. W. Neville, "Notes on Larvæ," it being the second of a series on the egg, larva, pupa, and imago. The subject was taken up from the deposition of the egg; he described the increase in size of some eggs by the absorption of air and water; yolk segmentation, the development of the embryo, the resemblance between some stages in the embryo and the course of life in certain lowly organisms; many degrees of advancement in larvæ; skin casting, its causes, &c., &c. The paper was illustrated by drawings and microscopical objects.—May 5th. Mr. Madison exhibited a distorted specimen of *Planorbis vortex* (the whorls being separated) from Yardley. Under the microscopes Mr. Dunn showed *Draparnaldia glomerata;* Mr. Tylar, *Arachnoidiscus ornatus* on *Sertularia abietina;* Mr. J. W. Neville, Oak Spangle Fly, *Cynips longipennis;* Mr. Hawkes, spores of *Equisetum arvense.* May 12th.—Mr. Darley showed specimens of larvæ of *Plusia iota* and *P. chrysitis.* Under the microscopes Mr. J. W. Neville showed *Ophiocoma neglecta;* Mr. Tylar, ova of *Gobius niger,* showing young fish; Mr. Hawkes, reproductive organs of *Nitella translucens.* A lecture was then given by Mr. H. Insley, on "Special Structural Botany." *Ranunculus acris* was taken as a type specimen, and the various parts described, from the root to the flower; also the different tissues of which the plant is built up. The subject was illustrated by diagrams, and a large number of preparations were shown under the microscopes.

BEDFORDSHIRE NATURAL HISTORY SOCIETY & FIELD CLUB.—On the 20th March an admirable paper was read by Mr. W. Steward, on "The Migratory Instinct of Birds." He treated the subject in an original method, and his views were thoroughly evolutionary. Going back beyond the Glacial period, Mr. Steward carefully traced the rise of this remarkable instinct, ably described its character, and suggested the conditions that would be adequate, if they were not actually known, to bring about by pure force of circumstances the migratory instinct of birds. Some slight discussion took place at the close, and a cordial vote of thanks, which he thoroughly deserved, was passed to Mr. Steward.—No meeting of this Society was held during the month of April. The annual meeting of this Society was held on the 8th of May. Mr. T. G. Elger, F.R.A.S., (honorary secretary), presented the following report of the Committee:—"The Committee have pleasure in presenting the ninth annual report. During the past year the following papers were read:—'Will it Rain? or weather-forecasting by means of the Spectroscope,' by Mr. T. G. Elger, F.R.A.S.; 'The Life of a Naturalist,' by the Rev. J. Copner, M.A.; 'On Vegetable Cells and their Contents,' by Mr. Hamson; 'On the Migration of Birds,' by Mr. W. Steward. The thanks of the Society are due to the authors of these papers and also to those members who exhibited specimens at the microscopical and other meetings. Although the number of papers contributed in the course of the past session is fewer than in any previous year, in other respects the Society has shown no lack of vitality. In the botanical section, especially, real progress had been made. Mr. J. Saunders, of Luton, to whom the Society is already so much indebted, has done good work in collecting and cataloguing the flowering and cryptogamic plants of South Bedfordshire, a very complete list of which, the result of his labours, will shortly appear in the Transactions. The want of equally active and energetic workers in the Northern division of the county is a pressing one, and forms the only impediment to the work of preparing for publication of the new 'Flora Bedfordiensis,' which the Committee trust will ere long be proceeded with. The Saturday afternoon excursions originated and conducted by the Botanical Secretary, Mr. A. Ransom, have been continued with success. Arrangements are in progress to organize, if possible, one or more excursions during the coming summer in connection with the Northamptonshire Natural History Society, of which due notice will be given. The meteorological observations, commenced nearly two years ago, have been systematically carried on, though from unavoidable causes the weekly publication of the results in the local papers has during the last six months been discontinued. The forthcoming report of the Committee will, however, include a summary of the records of all the instruments up to date. The scheme for organizing a system of popular scientific lectures in the county has been very successful. Lectures have been given at Kempston, Potton, and other places during the year, which were well attended and highly appreciated. The Midland Naturalists' Union, to which our Society is affiliated, hold their annual meeting this year at Peterborough, on 25th June. A wish has been expressed that the Union should be asked to meet next year at Bedford. It rests with the members of our Society to decide whether or no an invitation shall be given. Such a reunion of naturalists and men of science would be most desirable if it can be arranged, as it would instil new life into our Society and be the means of awakening general interest in Natural History in the town and neighbourhood. The Proceedings and Transactions of the Society from June, 1881, to the present date are in the press, and will soon be issued to the members."—Mr. Hamson presented the report of the Lecturing Committee, from which it appeared that in October last the Secretary was instructed to draw up a circular setting forth the provisions of the lecturing scheme, to have it printed, and cause copies to be sent to the principal officers of various local societies in villages near Bedford. At the same time the Secretary prepared a list of gentlemen (not necessarily members of the Society) who he thought would be willing to give lectures. There had been five applications received through the medium of the Committee, and the following lectures have been delivered: October

16th, at Kempston, "Cowper, as a poet of nature," by the Rev. James Copner; December 11th, at Kempston, "Pond Life," by Dr. Crick; January 31st, at Great Barford, "Salt and Sugar," by Mr. A. Ransom; March 3rd, at Potton, "The Cross Fertilization of Flowers," by Mr. J. Hamson; "Wild Flowers" and "Pond Life," by Dr. Crick, at St. Paul's Wesleyan School; March, 1883, at Kempston, "The Sun," by Mr. T. G. Elger; April 22nd, 1884, at Kempston, "Volcanoes and Earthquakes," by Mr. T. G. Elger. The Committee had reason to believe that the lectures were heard with intelligent appreciation, from the fact that on more than one occasion the interest of the audience was manifested by the discussion that followed. Mr. Arthur Ransom read a paper on "The office of Trees in the Economy of Nature," which awoke great interest, and was followed by an animated discussion.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY AND FIELD CLUB.—The annual meeting of the members of this society was held in the Museum, Dudley, on May 12th. Mr. H. Johnson, F.G.S., president, in the chair. The yearly statement of accounts and the report of the committee were read and adopted. Mr. H. Johnson was re-elected president for the present year. After the transaction of the business, Mr. G. Jones read an interesting paper on the metallurgical operations of Dud Dudley in this neighbourhood during the early part of the 17th century; Dudley's object was to smelt iron with coal instead of charcoal, as was then the custom, which had led to the destruction of vast tracts of forests in various parts of the country. Mr. Jones then conducted the party to Dibdale, where very much of this old scoria is still to be found, and he pointed out the site of some of the earliest blast furnaces in the district. He also called attention to the great quantities of calcined shale, frequently baked into porcellanite, lying about, and stated that in consequence of the coal measures cropping out, and being worked near the surface in olden time, together with imperfect modes of working, vast quantities of slack were left in the pits, which afterwards took fire, and then ignited the adjacent coal, so that it is estimated that hundreds of acres of coal were destroyed, the fires resembling, as Dud Dudley remarks, "Etna in Cicily, or Hecla in the Indies." The party then walked to Mr. B. Gibbons, junr's., fire-clay works, where Mr. Gibbons kindly explained the discovery of a patch of thick coal which had lately been found, and which had escaped the surrounding conflagrations. The members then drove to the Wren's Nest, where Mr. Johnson pointed out a most instructive section, showing the manner in which the limestone beds had been contorted by the forces which had upheaved them into their present inclined and almost vertical position.

TAMWORTH NATURAL HISTORY, GEOLOGICAL, AND ANTIQUARIAN SOCIETY.—On April 25th Mr. F. W. Andrews gave a lecture on "The Fertilization of Flowering Plants." He showed the intimate connection between the colours and scents of flowers, and the visits of the insects attracted thereby for fertilizing plants. As a practical application of the theory, he said the Australians have lately imported numbers of Queen humble bees for the greater fertilization of their red clover.—On May 12th Mr. J. Spencer Balfour, M.P., gave some notes from his Italian trip, which were thoroughly appreciated by a well filled room. An account is given in the *Tamworth Herald* of May 24th.

ON THE VOLCANIC THEORY FOR THE CAUSE OF THE RECENT REMARKABLE SUNSETS.*

BY W. P. MARSHALL, M.I.C.E.

The recent remarkable sunsets and sunrises have been so exceptional in character that it follows they must have had some exceptional cause, and the volcanic theory attributing this cause to the great Java eruption of the Krakatoa volcano in last autumn, although appearing on the first impression to be very wild and fanciful, has steadily made way, and has received increasing evidence in its support of an unexpectedly definite character.

Two other causes have also been suggested for these remarkable sunsets and sunrises:—

1st. The presence of an exceptionally large amount of moisture in the air.

2nd. A possible meeting with a diffused mass of meteoric matter in the interplanetary space passed through by the earth in its orbit.

There is now the means of testing these theories by some special circumstances attending the phenomena, which bear very definite evidence upon the question.

The first consideration is that there must have been a reflection of the sun's rays from some special stratum of material floating in the upper regions of the atmosphere at a much higher level than that of the clouds which produce the ordinary sunset effects. In those cases the sun's rays are reflected from layers of aqueous vapour, or more correctly layers of water-dust, or minute vesicles of condensed water produced by currents of warmer air charged with water in the invisible state of vapour coming into contact with colder currents, and forming by condensation at their surfaces of contact, sheets of this diffused water-dust of very various and irregular densities, forms, and thicknesses.

The main point to be ascertained for the consideration of the subject is the actual height in the atmosphere at which the reflecting surface was situated in the case of these special sunsets, and the principle of the calculation for ascertaining this is simple, and depends upon two measurements only, and first the actual extent of depression of the sun below the level of the horizon at the time of the phenomenon being observed. This is ascertained from the length of time that

* Transactions of the Birmingham Natural History and Microscopical Society. Read 22nd April, 1884.

has passed after sunset until the appearance of the phenomenon, and from the position of the place of observation upon the earth as regards latitude, or distance from the equator towards the pole. At the equator the sun in setting descends vertically in passing below the horizon, and as the whole circle of its course, 360°, is traversed in twenty-four hours, the extent of motion in one hour is 15°, which is the amount of depression of the sun below the horizon at one hour after sunset at the equator.

In our latitude of 52°, however, the course of the sun in setting is oblique to the horizon, and the deviation from a vertical direction is the same in amount as the latitude, or 52°; the consequence of which is that at one hour after sunset the sun instead of having descended 15° below the horizon is only about two-thirds of that amount, or 10° below. The extreme case of this difference is of course at the pole, where the latitude being 90°, the deviation of the sun's path from a vertical direction is 90°, or a right angle, and the sun travels round the horizon in a level course without rising or falling, being altogether above the horizon through the summer and altogether below through the winter.

The time of appearance of the special sunset and sunrise phenomena was about an hour after sunset or before sunrise, and the position of the sun at that time was, therefore, about 10° below the horizon in our latitude, consequently the angle was half that amount, or 5°, between the reflecting surface and the reflected ray. Then, as in any triangle all the parts can be calculated when any three of them are known, provided that one of the known parts is a side so as to give a measure of length; in the triangle that is formed by the horizontal reflected ray, the vertical line from the place of observation to the centre of the earth, and the oblique line from the reflecting surface to the same centre, one side is known to be 4000 miles length (being the half diameter of the earth), and two angles, 5° and 90°, are known (the latter being a right angle between the horizontal line to the horizon and the vertical line to the centre of the earth); the long side of the triangle can then be calculated, and amounts to 4015 miles, or 15 miles more than the distance from the surface to the centre of the earth, and this gives 15 miles as the elevation of the reflecting surface above the surface of the earth.

This calculation gives the height for a reflection at the horizon, but the special phenomenon was seen at an elevation of about 20° above the horizon, and a further calculation has therefore to be made for ascertaining the actual height of the reflecting surface at that elevation, and this gives 4042 miles as the distance from the centre of the earth, or 42 miles higher than the surface of the earth, or say *40 miles* as the height of the reflecting surface in the atmosphere after allowing for the disturbing effect of refraction in reducing the apparent depression of the sun below the horizon. This 40 miles was named by Helmholtz, junr., as the approximate height, calculated from observations at Berlin of the special sunset phenomena.

The theory of an unusual amount of aqueous vapour in the atmosphere as a cause for the phenomenon is seen to be untenable when this great height of 40 miles is recognised, because the limit of vapour in the atmosphere capable of forming clouds is much below that height, as the rarefaction of the atmosphere at that height may be considered much too great to allow of aqueous vapour being held there in the atmosphere of sufficient density to allow visible cloud to be formed or strata capable of giving a sunset reflection.

In the case of the other theory of diffused meteoric matter in the atmosphere as the cause of the phenomenon, it has to be noted that this matter would necessarily be diffused with an approximate uniformity over the whole atmosphere surrounding the earth, in the event of the earth meeting with and plunging into any collection of meteoric matter in the course of its orbit; this collection of matter being in front of the earth in its course, and the earth turning round completely in twenty-four hours, would result in a general distribution of the meteoric matter over its whole surface. But the consequence of this would be a simultaneous appearance of the special phenomenon in different parts of the earth, and this is directly opposed to the observed facts that the phenomenon was distinctly local, and travelled over the surface of the earth with great uniformity of motion. There were two different directions and rates of motion: first a direct westerly translation near the line of the equator that was traced three-quarters of the distance round the earth at a very uniform speed of about 70 miles an hour; and secondly a much slower diffusion northwards and southwards, reaching 30° from the equator in about a month, 50° in three months, and 60° in four months. In the chart given in the former paper upon this subject ("Midland Naturalist," Plate I., January, 1884), the westerly travel of the phenomenon is shown at 12,000 miles distance, or halfway round the earth in a week; and since that time information has been received of its reaching the Sandwich Islands at 18,000 miles distance, or three-quarters round the earth, in ten days, both observations agreeing with an average speed of about 70 miles an hour.

These circumstances seem to limit the possible cause to something actually local, and the volcanic theory suggests that this cause was the discharge into the atmosphere at the eruption of Krakatoa, on 26th August, of an enormous quantity of volcanic matter, possibly melted lava blown into a very finely divided vesicular state by the bursting through it of an explosion of steam at a very high pressure; that this erupted matter was projected to an exceptionally great height in the atmosphere and formed an immense cloud that remained suspended there for a great length of time, on account of the slow rate at which the particles would be able to fall through the atmosphere, and also the mutual repulsion of the particles, and their repulsion by the earth due to a highly charged electrical condition from the great electrical disturbance accompanying the eruption; that this cloud of erupted matter remained stationary at the spot where it was projected in the upper regions of the atmosphere, but that the atmosphere at that height does not partake of the full velocity of rotation of the surface of the earth and of the atmosphere that is in immediate contact with the earth, lagging behind about seven per cent. of the equatorial velocity of 1000 miles an hour, which resulted in an apparent westerly movement of about 70 miles an hour; according with the westward travelling of the special phenomenon that was observed for as great a distance as three-quarters round the earth at an approximately uniform rate of motion; that the mass of suspended matter became gradually and slowly diffused laterally in the atmosphere, being assisted in northward and southward dispersion by the continuous polar currents of the upper regions of the atmosphere, due to the vertical displacement of heated atmosphere rising in the equatorial region, and causing the phenomenon to become visible successively at places more and more distant from the equator.

Such a height in the atmosphere as 40 miles above the earth's surface appears on first impression to be extravagantly great; but when looked into it will be seen to be not unreasonable in comparison with the known dimensions of inequalities of the earth's surface. The highest mountains reach about 5 miles vertical height, and the greatest depths of the sea also reach about 5 miles, making together 10 miles inequality of the earth's surface. The 40 miles height in the atmosphere is only four times this amount, and when looked at together it does not appear too much to suppose volcanic matter to be ejected in an eruption to four times the height of that inequality.

Another point of view for this question is a comparison with the greatest height that has been attained of balloon ascent in the atmosphere, which reached as high as 7 miles in one case, or 2 miles above the highest of the mountains, in an ascent made by Mr. Glaisher and Mr. Cox at Wolverhampton, 5th September, 1862, and the height of 40 miles for the volcanic matter is only about five-and-a-half times that amount.

It has been suggested that this volcanic matter was projected into the atmosphere by the Krakatoa eruption, in the form of minute hollow glassy vesicles produced by an explosion of steam at enormous pressure bursting through a bed of melted lava, and that these particles remained suspended for a long time in the atmosphere, and were caused to take a very long time in falling back to the earth on account of their extremely small actual weight of material, which would be further reduced by the internal vacuum arising from condensation of contained steam, and on account of the large surface exposed by the hollow vesicles in relation to their weight. Also in consequence of the excessive electrical disturbance that accompanied the eruption, these particles would be highly electrified, and would, therefore, forcibly repel one another, and would also be repelled by the earth, from its being in a similar electrical condition; and this state would continue for a long time with little diminution, on account of the highly rarefied atmosphere being a good insulator, as proved in Mr. Crooke's radiometer experiments.

In considering the volcanic force of eruption requisite for projecting matter to so great a height as 40 miles, it has to be noticed that on account of the reduction in the density of the atmosphere, its resistance to the passage of a projected body is enormously reduced at that height, the density diminishing in a geometrical proportion as the height increases in an arithmetical proportion. That the eruption in question of the Krakatoa volcano was of a very exceptional character, and one of the most extensive on record in the force of the explosion, is shown by definite evidence of various kinds. More than one half of the island of Krakatoa disappeared in the eruption; a great tidal wave of 100 feet in height was produced in the ocean, the effect of which extended to harbours round the entire circumference of the earth; the sound of the explosion was heard at 1200 miles distance, at Baugney, on the further coast of Celebes; and the fall of ashes extended to a distance of 1000 miles, being received by a vessel off the western coast of Australia. There is fortunately also the record of another vessel which was within only 40 miles distance of the volcano at the time of the eruption, and this vessel, the "Berbice," received a continuous fall of mud and ashes for two days, causing total darkness for thirty-six hours, during which an accumulation of three feet depth was formed upon the deck, and the masts and rigging were so encrusted that upon the return of light the ship looked as if it had been dug out of the mud. The captain of the "Berbice" has now, through his friend Mr. Ross, the captain of the Society's dredging steamer at Oban, sent the Society a large specimen of the floating pumice stone which covered the sea for many miles in the neighbourhood of the eruption, and a quantity of the deposit that fell upon the deck of the ship.

The following is an extract from the log of the "Berbice":—

"Sunday, August 27th, 1883.

"At 4 p.m., having a very threatening appearance in the south-east, deemed it prudent to make fast all small sails, and stand the ship off to seaward, it becoming unusually dark for that hour of the day. 5 p.m., a light fall of fine ashes, accompanied with lightning and thunder; made fast all canvas. 6 p.m., total darkness, with an increasing fall of ashes, accompanied with heavy lightning and thunder; balls of electricity bursting on all sides of the ship. Midnight, a terrific gale, accompanied with a blinding and cutting fall of ashes, with most fearful lightning and terrific peals of thunder, shaking the ship from stem to stern; balls of electricity bursting above us and striking different parts of the ship and masts. 4 a.m., storm somewhat abated, but ashes still falling in torrents. 8 a.m., gale increasing; ashes falling faster and heavier; lightning and thunder getting worse. 11 a.m., still total darkness; blowing a fearful hurricane; lightning and thunder most terrific, appearing like as if the heavens had opened upon us, thinking that the next moment would be our last. 4 p.m., still total darkness; lightning and thunder fast abating, but ashes still falling heavily. 5 p.m., ashes being about three feet deep on the ship's deck, deemed it prudent for the safety of our lives and ship to light lamps and try and shovel some of it overboard. 8 p.m., lightning and thunder still abating; ashes not falling so heavily. Mid sky breaking, but still a light fall of very fine ashes, but having every appearance of finer weather. 4 a.m., daylight received with a glad welcome, after a most fearful and total darkness for thirty-six hours—a grand but not a pleasant sight, ship appearing to have been dug out of the mud; masts and ropes coated with ashes four times their original size."

The strongest evidence, however, of the exceptionally great extent of the eruptive force in this volcanic outburst is afforded by the change effected in the surface of the earth by this explosion. The island was previously five miles long and three miles wide, having the volcanic cone of Krakatoa rising from it to nearly 3000 feet above the sea; this volcano had long been dormant and its slopes were covered with woods; a period of two centuries having passed since it showed any volcanic action. In the present eruption more than half the island disappeared, a portion measuring three miles length by two miles average width having not only gone, but there is now a depth of nearly 1000 feet of water on the spot. At the same time two new islands have appeared, at eight miles distance, one of them being where there was previously a depth of 150 feet of water; and the island to the west of Krakatoa has been more than doubled in size.

This extraordinary disturbance of the surface of the earth caused a gigantic tidal wave which travelled from Krakatoa east and west completely round the earth; and from the numerous records of the tide gauges that have now come in from all parts of the world it has been ascertained that these two waves met on the opposite side of the earth from Krakatoa and did not vanish there, but crossing each other, journeyed on to their starting point, and actually then proceeded forward again as before and repeated their journey round the earth, performing this course, it is stated, no less than four times before the equilibrium of the sea was restored so far as to be insensible by the instruments of observation. This great wave transmitted through the water is now found, from the delicate barometrical registers in numerous parts of the world, to have had a parallel in the atmosphere, in an atmospheric wave also transmitted round the earth from this gigantic and unprecedented explosion. This atmospheric wave has been traced in its progress in both directions round the earth, and is found to have travelled with the same velocity as sound waves are transmitted through the air. There appears reason to suppose, from the enormous quantity of floating pumice that appeared at the time over a wide area of the sea, that the main eruption was a submarine explosion at some distance westward from Krakatoa, and that the Krakatoa eruption, gigantic as it was in extent, was really only a secondary symptom of a still greater Indian Ocean eruption.

When there is taken into consideration the enormous explosive force that must have been in action to produce such an effect as the bursting asunder and rooting up of a mass of the island of Krakatoa so large as three miles length and two miles width, leaving deep water in its place, and perhaps projecting this mass to a distance of eight miles, where two new islands were found after the eruption;—the feasibility of the idea that has been suggested of minutely divided volcanic matter having been projected by the same explosion to a height of forty miles in the atmosphere receives an important support, and the volcanic theory for the cause of the recent remarkable sunsets advocated in the former paper on the subject is further confirmed.

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 153.)

e.—The Spores.

During this time the contents of the sporange have been resolving themselves into spores by free cell-formation. There are two modes of formation of spores which are sometimes confused under this name :—Firstly, as in some species of Peziza, the cell-nucleus divides into two, then into four, and lastly into eight smaller nuclei, each of which surrounds itself with a portion of the protoplasm and constitutes a spore; secondly, as is described by De Bary in his account of the formation of the spores of Protomyces, the protoplasm may fall *simultaneously* into as many parts as there are to be spores, without the previous subdivision of a nucleus—in fact, the nucleus, if there has been one, disappears entirely as a preliminary of this process. There is a difficulty in observing the operation in Pilobolus, as, on account of the opacity of the membrane, the spores can only be seen by lightly pressing the sporange and observing those which protrude through the crack, with as little disturbance as possible. But after many trials I have come to the conclusion that the spores are formed in the following way.

The contents of the sporange are mainly twofold, the protoplasm proper, with the granules, and a hyaline homogeneous substance, the epiplasm. At the beginning these are thoroughly intermixed. The first stage in spore-formation is that the granules range themselves in short lines, which anastomose with one another, and form a regular "all-sided"* network, filling the whole interior of the sporange, its meshes being about the size of the future spores. The interstices

* *I.e.*, extending in three dimensions of space.

are filled with homogeneous epiplasm (Fig. 6). When this preliminary marshalling is completed the bounding lines of granules widen, and then a transfer of the granules takes place comparatively suddenly; they pass from the sides of the meshes into the intervening spaces, falling together, as it were, from all sides to form little roundish or oval balls of granules, separated by a network of homogeneous substance. Each mass of granules then surrounds itself by a cellulose membrane, the granules are dissolved, and we have, according to the species, round or ellipsoidal homogeneous yellowish spores, embedded in a substance of a gelatinous nature, which is perfectly colourless, and binds the whole mass of spores together. This interstitial substance has an important rôle to play, as we shall see, in the economy of Pilobolus.

Since writing the paragraph just given, I have met with a description of the formation of the spores of Pythium and Achlya, by Marshall Ward, which bears striking testimony to the affinity of those genera to the Mucorini. In that author's description of the formation of zoospores in the sporangia of *Achlya polyandra** the identical phenomenon which I have just referred to, of the preliminary marshalling of the granules in a network, is repeated. In *Achlya apiculata* † we have the same occurrence of a network of granules, followed suddenly by the production of a granular grey uniform mass; a vacuole or clear space then develops, probably in the centre of each original mesh, and the lines of division of the zoospores are formed. He also seems to attribute exactly the same process to the formation of the zoospores of *Pythium proliferum*.‡ These phenomena are also described by De Bary as occurring in the formation of the spores of Protomyces.§

The spores are arranged, for the most part, in regular layers, so that in an absolutely perfect sporange there would be a number of concentric shells, each composed of a single layer of spores, and the spores in each layer would be placed side by side, like cannon balls at a government arsenal. It is difficult to see this regularity, since the necessary manipulation usually destroys it, but I have on many occasions seen an approach to it in carefully compressed sporangia, when the membrane was unusually transparent. We know that in eight-spored asci the spores are frequently arranged in one or two perfectly regular rows with their axes parallel, but I have

* Quart. Journal Microscop. Science, 1883, p. 276, pl. xxii., fig. 1, *d-f*.
† *L.c.*, p. 284, pl. xxii., fig. 16, *a-b*; fig. 15, *d*, *e*.
‡ *L.c.*, p. 499.
§ Beitr. zur Morph. und Phys. der Pilze, ser. 1, pp. 145-6, pl. 1, fig. 14.

never seen it stated that the same regularity extends, in an appreciable degree, to sporangia containing, like those of Pilobolus, many hundreds of spores; my observations have shown me that it is often so.

f.—The Columella.

While these changes are taking place in the sporange the perfectly plane septum which arose at first at the top of the stem, and the upper portion of the stem itself, have been undergoing transformations in form no less important. The upward tendency of the protoplasm, which must apparently be looked upon as a vital movement admitting of no further analysis, steadily continues and exerts a pressure upon the septum, which causes it to grow upwards in a bluntly conical form within the sporange (Fig. 10), and thus produce the *columella* so characteristic of the Mucorini. The columella, rising as it does among the spores, and displacing some of them, must cause a considerable pressure upon the wall of the sporangium, but, as the upper portion of this is already more or less cuticularised and capable of withstanding the strain, it follows that the whole effect must fall upon that infra-equatorial zone, before mentioned as exempt from the cuticularisation, which certainly is found to be, in the mature sporange, much thinner and more fragile than it was at first.

It is curious to observe the difference between the behaviour of this septum, and of the one at the base of the stem. The lower one is pervious to the protoplasm, and remains always plane; the upper one is impervious, and is consequently forced up as just described.

g.—The Swelling.

The upper portion of the stem also yields to the pressure from within, and is swollen out into a more or less globular or ovoid form, characteristic of each species, which I shall call the *swelling*. At the base this swelling passes into the stem with more or less abruptness, and below this the stem remains, except in *P. œdipus* (Fig. 14), perfectly cylindrical down to the basal reservoir. The whole of the yellow granular substance is not absorbed in the formation of the sporange; a small portion remains in the stem. The supply from the mycelium still continues, and the basal reservoir is often nearly full. That part which remains in the stem is distributed in a peculiar manner. When the swelling is already nearly completed, but the columella not yet elevated to its final height, streams of yellow granules may be seen proceeding upwards, like the lines of longitude on a globe, as represented in Fig. 12; finally the granules become arranged in an annular zone (Fig. 8*d*), in close contiguity to the wall of the swelling, just beneath the circle of junction with the columella. Besides this another mass usually accumulates at the point where the swelling shades into the stem, in the form of a horizontal yellow disc, thinner towards the middle than at the circumference, and probably always still leaving a slight opening of communication in the centre between the stem and the swelling (Fig. 12*a*). This was mistaken by Coemans for a septum.

In the other parts of the stem and swelling the walls are lined by a layer of protoplasm (Fig. 12) containing few granules, and in consequence appearing almost colourless. The central space is filled by a fluid like water, but of greater refractive index; it is this that condenses the light, so as to produce that beautiful effulgency by which the tiny individuals of Pilobolus attract attention, and which seems to be similar to the corresponding phenomenon so well known in the case of the "cavern-moss," *Schistostega osmundacea*.

(To be continued.)

THE ETHICS OF SOCIOLOGY.*

BY W. H. FRANCE.

It may be, and probably is, thought that what I am about to read, especially under such a title as "The Ethics of Sociology," is more suited to the Sociological Section. As a matter of fact it was indeed penned with that intention, and for that and other reasons I must ask you to be good enough, for a short time this evening, to fancy yourselves members of that section.

We have heard of the man who, without knowing it, was addicted to expressing himself in prose. I know that there are many amongst us who, though in some cases quite unconsciously, are very creditable Sociologists. It will be sufficient for our purposes this evening for me to define a Sociologist to be one who, conscious of social defects, is desirous of social remedies.

That definition is, I venture to hope and believe, of sufficient breadth to provide comfortable space for everyone here this evening.

* Transactions of the Birmingham Natural History and Microscopical Society. Read April 1st, 1884.

When at one of our past meetings I ventured to suggest that in assuming the title of Sociologists we were incurring a responsibility beyond that of the mere study of Mr. Herbert Spencer's invaluable literary works, I must admit that I did not expect to be called upon to give suggestions as to the scope of our proceedings as professing Sociologists. I do not, however, regret my presumption. Though I should have preferred to have been critical rather than suggestive, I am none the less conscious that to be critical and not suggestive also is of but negative value to any association.

Having ventured upon criticism, I accept, as best I may, the concurrent duty of suggestion also. When I was asked to become a member of the Birmingham Natural History and Microscopical Society, I consented for reasons which, on self-examination, I discovered were chiefly selfish ones. As an ardent lover of Nature in the abstract I felt that in joining the Society of which this is a section I should have opportunities of tasting of the fruits of the labours of others who, in their respective studies of natural subjects, have advanced so much beyond what I dare hope to discover for myself. I had some qualms of conscience as to whether I could honestly associate with specialists. Such fears were, however, quickly dispersed. I soon discovered that our worthy Chairman, as a Zoologist; our President, in Geology; Mr. Bagnall and Mr. Grove, in Botany and Mycology; Mr. Chase, in Ornithology; and others wandering lovingly over the varied and intersecting paths of study in Nature, were, one and all, desirous to enlighten the ignorant. I felt that I was welcome to help myself to any and all of the varied feasts of knowledge spread before me. Like a child wandering in a new world of wonders, as each subject was presented to my mind, I thought it the most beautiful of all. I experienced a great accession of that reverential love of Nature as a whole which has of late years made me joy in the consciousness that the beasts and birds, insects and fishes, the trees of the forest and the flowers of the field, are my relations and companions in life.

The more we learn what life is, to them and to us, the closer does this universal relationship and inter-dependence reveal itself to be, and the dearer does their companionship become. The more extended knowledge of that struggle for existence which we share with all other forms of life is becoming a great factor in our civilisation. We are learning to better distinguish between friends and foes to our position at the head of life. The Life-history of plants and animals, and even their Family Faculties, are being accurately recorded, and are influencing our lines of thought and action, and are making themselves felt in legislative enactments. The Acts of Parliament passed for the protection of bird life; the prevention of cruelty to animals; the preservation and development of river and sea fish, with the resulting sympathy excited in the human breast on behalf of forms of life within our power to destroy, are mainly due to the work of the naturalist. He it is who tells us what with safety to ourselves we should let live for food, companionship, or beauty.

Thus, through the naturalist, are we linked in mind as in body with everything around us. The more desirous are we to avoid unnecessary cruelty, the strength of which desire is one of the surest tests of civilisation and progress.

If the geologist desired but to count the strata of the earth's crust; if the botanist only cared to enumerate orders, species, and varieties of vegetal life; if the zoologist and the chemist had no higher aims than to discover variety of form and force, surely lives so spent would be lives wasted in that which would be profitless.

But such is not the case. That which we call civilisation is an edifice constructed of materials hewn out of every branch of human study and elucidation.

Each department of Nature is a series of well-fitting sections of a glorious picture-puzzle. Each earnest student may discover and place in its right position some portion of that picture. Happy is he in proportion to his success in adding to the grandeur of the whole. The smallest measure of success becomes a germ for subsequent development. Progress may be slow,—it is indeed often slowest in that which is of most general and permanent benefit,—but it is none the less sure.

As I become more intimately acquainted with the loving devotion to their respective studies on the part of our specialists, I am reminded of a question even yet to be heard from the lips of those who, perhaps of all others, derive most benefit from scientific research—I mean those who utilise, but do not discover. The men to whom the acquisition of the material wealth of others is the sole incentive to energy of mind and body, and who to that end avail themselves of what the scientist has discovered—in tones not unmixed with envy, such people ask "In what does your science help you to get on?"

Now, "get on" is a very indefinite phrase. If for its definition I question the Ascetic in religion, he will tell me that to "get on" is to progress in the substitution of spiritual for material desires.

If I ask the Commercial Ascetic he unhesitatingly affirms that to "get on" is "to employ as few men as you can, work them as hard as you can, pay them as little as will retain their services, and accumulate wealth as if for life here and hereafter;" and, it may be added, die in poverty as a millionaire.

With some exceptions, those men of Science, Art, and Literature, who have done most to benefit mankind, have, in a material sense, derived comparatively little from their labours, and yet how wealthy are they in posthumous appreciation! To question *them* as to what constitutes "getting on" is to have it defined as the acquisition and distribution of knowledge. An acquisition, which, unlike that of commerce, is not obtained at the expense of human suffering and loss. A distribution free from the defects of charity, in that it is the more helpful, as it is more dispersed.

It is needless to trouble ourselves with further inquiries, only to obtain greater confusion of thought as to what is implied by "getting on." They may be grouped into three orders:—The first, Idealistic;—Secondly, The practical only;—and thirdly, A combination of the two first.

Now the Idealistic may be, and generally is, ridiculed by the practical minded only, but human progress in civilisation must ceasewith Idealism; without an ideal, development is impossible.

Ideals are to us what the bloom is to the seed. Each is an incentive to something higher and nobler. When the plant has bloomed it has attained to its ideal, and the seed falls only to repeat the struggle. Or, mayhap, its fall may mean extinction.

In like manner have nations bloomed and faded as their ideals have been kept within practical limits. Only so long as the ideal, as a motive, is in advance of the practical, can individuals and nations progress in civilisation and culture. Whilst the practical is subservient to the ideal, life is vigorous and progressive.

It is not even necessary, perhaps not desirable, that the ideal shall be capable of definition, The evolution of organic bodies adapts itself to the varying conditions of life. So must our ideals.

We commence life with such a burden of ignorance that to be rid of it *all* would require constant efforts for more years than are allotted to man. Still, the process is so fascinating that possibly life without ignorance would be a dull affair.

To hunt out and destroy misconceptions, and store in their place that which shall shed more light on all around us, developes our imaginations and instils desires for something higher.

Such desires should be especially strong in the minds of Sociologists. They must of necessity look upon much that is painful and perplexing. Social problems are numerous and intricate. As with a tangled skein, often there appears to be no alternative but to sever the thread. Impatiently to tug at them is to make matters worse. Patient and determined efforts are generally best. Students of society should be desirous to rectify that which it may be possible for them to improve. That which may ultimately prove a possible finality, is so far removed from our sight as to suggest a limitless ocean for our sails. Shall we be content with attaining to that point which others have deemed sufficient, and, consequently, foundered?

The answer to that question must come from the Sociologist. On him primarily depends the issue. So long as he mans the ship of human progress, built on lines laid down by students of Nature, will progress be possible. He knows best how to trim the social sails to catch the favouring breeze. The point for which he aims must be as unattainable as are the stars by which the mariner steers his ship with more certainty than by the quivering compass.

It is a glorious Priesthood!

He who dons its garb should be indifferent to all that cannot contribute to its divine aspirations.

High Priests lead the way. Conspicuous amongst them is Herbert Spencer. Long ages after his body has fed the flowers will his mind lead men and women on in that procession yearly, daily swelling till it be joined by all Humanity. That is the aim of such men as he.

Was it to gain material wealth that for fifteen years of his life he steadily held aloft the lamp of knowledge without pecuniary recompense? I presume that at no time of his life has money-making been his object. He is too valuable to others to gain much himself. The incalculable wealth of light which emanates from his mind, stored as it is with the force of knowledge, is shedding its rays east and west.

America responds to it, Japan lights up her schools with his works. Ably seconded as they are by the writings of many others, I am convinced that their influence will be increasingly great.

I am glad that our first efforts as a society are devoted to the study of Spencerian lines of thought. He himself enjoins us to do so as a preparation for practical application. Surely the harvest is ripe, even to rottenness! The field of humanity is full of noxious weeds which choke healthy development. Those who cannot see them are incapable of assisting in the work of social improvement. They belong to those requiring the attention of Sociologists. They are to be found in every section of Society, but most often amongst the extremely poor and the self-indulgent wealthy.

High thinking has ever been pretty closely associated with plain living. The pampered body is not a congenial home for noble sentiments.

The prancing steed is more likely to kick than assist the overworked of his species.

I will not insult the intelligence of my hearers by attempting an enumeration of social problems calling for solution. Each Sociologist worthy the name believes one or more of them to be of first importance. It is his or her duty, as a member of a Sociological Society, to acquaint himself or herself with the facts of, or relating to that subject. These, after due collation, should be brought under the notice of, and discussed by fellow-workers.

Here let me say that I should view with as much distrust, discussions and decisions exclusively confined to my own sex, and not participated in by lady Sociologists, as I should if men were excluded from the consideration of such matters. I will go further, and say that of the two evils, I would prefer subjecting myself to the Sociological decisions of ladies only, rather than to such as men only would be likely to impose. Notwithstanding the fact that woman has hitherto had little or no training for public work, she has very conspicuously displayed a more than average ability for its duties on school boards, and in the administration of the poor laws.

I would therefore urge that we do what may be necessary to induce ladies to join us in discussing questions of a Social nature.

Socially, numerically, and individually, woman is at least as important as man.

When on one occasion I was the guest of Professor Draper, of New York, I expressed my admiration for the position which woman holds in the United States, and remarked that I considered woman's position in any country to be the most sensitive test of the civilisation of that country.

To this Mrs. Draper remarked, that from what she had seen and learnt of English society, she thought that we ignored the fact that woman is mother to the man, and is pretty certain to transmit to him her defects, whatever they may be. That this must be so, a moment's reflection will convince us. If only for selfish reasons, how anxious then should we be that woman—mentally and physically—shall be qualified for the influence she must have in the well-being of Society.

Shape our course as we will, either for business or pleasure, we men—however little we recognise the fact—are, in all we do, mightily influenced by the domestic power of woman. Then let us have her counsel.

As with our own, it may not always be practicable.

It will be at least as pure, and more unselfish. More, to listen to her, to consult her, is to disarm her, and shield us from the worst fate which can befall our sex, viz., woman's distrust!

So far our Section is in the budding stage.

I have no wish that we shall separate ourselves from the parent stock and set up an independent existence; but healthy budding involves an increasing self-dependence for nutrition; this must come from extraneous sources.

Why should we not cordially ask the co-operation of those willing to join us on terms not reasonably deterrent to rich or poor?

Either under the name of associates, or as full members of our Sociological Section, I would suggest that the general public be invited to join us at a nominal subscription of—say 2/6 per annum.

We should derive, and I trust confer, advantage by a wider interchange of ideas than is possible under our present restricted operations.

Such subscriptions would also probably enable us to meet our Sectional expenditure without taxing the funds of the parent Society.

You will see from what I have already said how extensive—how limitless—a scope I conceive is attached to our title.

The study of books is essential to the work, but chiefly to forge mental tools, wherewith to deal with the complex problems of life.

Not to use such tools when made is a waste of time and material, and would render us unworthy the title of Sociologists.

A Manual of the British Discomycetes, with descriptions of all the species of Fungi included in the family, hitherto found in Britain and illustrations of the genera, by William Phillips, F.L.S., is announced as in preparation and shortly to be published in 1 vol., 8vo., cloth. The price will not exceed ten shillings, but in order to its publication at a lower price the names of subscribers are solicited, which should be sent to Mr. William Phillips, Canonbury, Shrewsbury.

BIRDS OF THE NEIGHBOURHOOD OF BIRMINGHAM.*

BY J. BETTERIDGE.

The following list of birds met with in a day's ramble will be interesting to ornithologists and other lovers of Nature by showing what "feathered friends" we have still in our neighbourhood, and although our rapidly increasing town is fast encroaching on its green border lands, yet a walk of a few miles will take us into a pretty undulating country, sweet with the songs of birds, and the home of a greater variety than many might imagine. It must not be supposed that this is a catalogue of the birds of a district, but simply a list of those observed in a day's ramble in the middle of May. The road taken from Birmingham was through Rubery and Cofton to Hewell. The various kinds of birds seen numbered sixty-two, and were as follows:—

Kestrel	Falco tinnunculus.
Sparrow Hawk	Accipiter nisus.
Spotted Flycatcher	Muscicapa grisola.
Mistletoe Thrush	Turdus viscivorus.
Song Thrush	Turdus musicus.
Blackbird	Turdus merula.
Hedge Accentor	Accentor modularis.
Redbreast	Erithacus rubecula.
Redstart	Ruticilla phœnicurus.
Whinchat	Saxicola rubetra.
Wheatear	Saxicola œnanthe.
Sedge Warbler	Salicaria phragmitis.
Nightingale	Luscinia philomela.
Blackcap Warbler	Sylvia atricapilla.
Garden Warbler	Sylvia hortensis.
Whitethroat	Sylvia cinerea.
Lesser Whitethroat	Sylvia sylviella.
Wood Warbler	Phylloneuste sibilatrix.
Willow Warbler	Phylloneuste trochilus.
Chiffchaff	Phylloneuste rufa.
Wren	Troglodytes parvulus.
Tree Creeper	Certhia familiaris.
Great Tit	Parus major.
Blue Tit	Parus cœruleus.
Coal Tit	Parus ater.
Long-tailed Tit	Acredula rosea.
Pied Wagtail	Motacilla Yarrelli.
Ray's Wagtail	Motacilla Rayi.
Tree Pipit	Anthus arboreus.
Meadow Pipit	Anthus pratensis.
Skylark	Alauda arvensis.
Black-headed Bunting	Emberiza melanocephala.

* Abstract of a Paper read before the Birmingham Microscopists' and Naturalists' Union. May 19th, 1884.

Yellow Bunting	Emberiza citrinella.
Chaffinch	Fringilla cœlebs.
Goldfinch	Fringilla carduelis.
Linnet	Linota cannabina.
Redpole	Linota linaria.
Tree Sparrow	Passer montanus.
House Sparrow	Passer domesticus.
Greenfinch	Coccothraustes chloris.
Bullfinch	Pyrrhula vulgaris.
Starling	Sturnus vulgaris.
Rook	Corvus frugilegus.
Magpie	Pica caudata.
Jay	Garrulus glandarius.
Cuckoo	Cuculus canorus.
Swallow	Hirundo rustica.
Martin	Hirundo urbica.
Sand Martin	Hirundo riparia.
Swift	Cypselus apus.
Ring Dove	Columba palumbus.
Turtle Dove	Turtur auritus.
Partridge	Perdix cinerea.
Pheasant	Phasianus colchicus.
Lapwing	Vanellus cristatus.
Common Sandpiper	Tringoides hypoleucos.
Land Rail	Crex pratensis.
Moorhen	Gallinula chloropus.
Coot	Fulica atra.
Wild Duck	Anas boschas.
Great Crested Grebe	Podiceps cristatus.
Little Grebe	Podiceps minor.

PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Mr. Barratt's Note.

BY LAWSON TAIT, F.R.C.S.

I am well aware that the "Midland Naturalist" is not intended to be the medium for the discussion of such abstruse questions as those raised in the fifth and sixth chapters of Mr. Herbert Spencer's Principles of Biology; but perhaps you will allow me very briefly to indicate one of very many reasons why I, as a follower of the philosophy of evolution as built up by Charles Darwin, cannot be a disciple of Mr. Herbert Spencer, and I know that many far more important people than I have encountered similar difficulties. Mr. Herbert Spencer's philosophy every now and then gets altogether above the facts of a case and violently tramples them down. Mr. Barratt in his brief note points out that differences of longevity appear to contradict Mr. Spencer's views of the nature of life. This is really a very mild statement of the case. I think these differences make Mr. Herbert Spencer's views impossible. Mr. Barratt, with the praiseworthy enthusiasm of a disciple, endeavours to show by a method as novel as it is ingenious, that the differences are only apparent, and that to estimate longevity we must count in as divisors a number of what Mr. Spencer would define as "individuals" (and see the awful contradiction on p. 205, Vol. I.) who have never lived at all, save in some kind of Spencerian sense. But suppose we do this, how much nearer are we to arriving at a reconciliation of the facts with Mr. Spencer's views? Let us take the case of the elephant and man. I suppose that Mr. Barratt will admit that the latter enjoys a very much higher form of life than the former—if not, of course my argument is gone. The elephant is an animal possessing a very well marked œstrus, occurring at very long intervals, pregnancy is very protracted, being the longest that is known, and the number of young produced is very small. The longevity of the elephant is also known to be very remarkable, and as these animals have been domesticated for centuries, all these facts are indisputable. Man is an animal, on the contrary, with no œstrus, with a comparatively short period of pregnancy, and a tremendous infantile mortality.

If Mr. Barratt is going to include "all the children of the tree," he must take all the children of other animals; and before that is done he must again appeal to Mr. Herbert Spencer's illustration of the *Anacharis Alsinastrum*, and define strictly what is a child and what is not; for there are children of two kinds of begettings: there are the zoospores and the zygospores, the cuttings and the fertilized ovules, the bulbiferous ferns, and many other irreconcilables. He must lay down a strict statement as to whether impregnation is a necessary part of the definition of a "child of a tree," and if not he must include all the unfertilised ovules as well as the seeds of the oak, the fertilised ovules.

Bringing this line of argument to bear on my illustrations of the elephant and man, as ovulation is rare in the elephant and as it is constantly going on in the human being from the cradle to the grave, as the human ova which are shed number probably a thousand to one of the ova of the elephant, as the children of the human race are infinitely more numerous and the whole race far more short lived than occurs in either case with the elephant, we cannot admit Mr. Barratt's explanation, and I for one must adhere to this very fatal objection to Mr. Herbert Spencer's views of life, and therefore to the whole system of Biology which he has built upon them.

So far as my limited judgment can go, the difference between Darwin and Spencer is pretty much the same as that between history and fiction.

Birmingham, June 11th, 1884.

ICE ACTION IN THE VALLEY OF THE ARTRO.

This valley trends westward to the sea, through the district called Ardudwy, comprising a large part of the county of Merioneth, near Harlech, between mountains and sea, a tract notable for its number of Cromlechs and Druidical remains of several kinds. But I wish to call attention to some remarkable evidences of Ice Action in this particular valley, below the ancient Pass through the mountains, a narrow ravine called Bwlch Drws Ardudwy, of surpassing ruggedness and grandeur. Below the Pass, where the valley begins to widen, and especially as you stand at the upper bridge spanning the rapid Artro, nearly the whole of the many bare rock surfaces are seen to be strikingly glaciated, the smoothened faces curving often slightly over, away from the Pass, in the direction the ice must have taken. Passing recently three times through the valley, I stayed to examine the rocks. One long surface, inclined at a considerable angle, I measured to be about sixty-four paces long, or perhaps about sixty yards, planed over most smoothly and having a number of large grooves, some of nearly semi-circular section, and two inches or more in width, generally straight, and often crossing the old cracks in the rocks—a very fine example of an ice-planed surface. Others are of various lengths, many long, scattered about the entire upper valley, and generally rough and broken only on the side fronting approximately down towards the sea, affording a most marked contrast to the surfaces towards the mountains. This valley becomes a little lower down of a width of half a mile or more, before the ordinary tree-clad glen is reached, and is so long as to contain the sites of the three old Tarns now silted up; and across this the glacier must have spread, up to a great height. Scattered about, and often catching the eye by their peculiar positions, are many great blocks brought down from the mountains. One I measured is about 7 feet $\times$ 6 feet 8 inches $\times$ 4 feet 4 inches, and rests on a bare rock. Just beyond is a picturesque fall of the beautiful Artro, rushing along through rich oak woods. The Pass itself forms a wondrous scene of power, of old commotion and present rest comparatively. From a height of 1,500 or 2,000 feet on both sides of you, as you stand in the jaws of the rocks, where are two or three little Moraine Mounds, the mountains are seen to be broken down in gigantic blocks or terraces from top to bottom, down to your feet, with difficult passage effected through them in some far-gone time; with savage recesses high above, whence a great part of the mountain has been torn out. This spot is about half way along the range running from Barmouth to near Maentwrog, and is but little known comparatively, being somewhere about five miles from Llanbedr, the nearest village, and formed in the great development there of the Cambrian Rocks.—HORACE PEARCE, F.G.S., Stourbridge.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(*Continued from page 157.*)

URTICACEÆ.

PARIETARIA.

P. diffusa, *Koch.* *Pellitory of the wall.*
Native: On old churches, ruins, and old walls. Local. May to October.
I. Old wall, Gilsdon, *W. B. Grove;* old walls of Nuneaton Abbey; old walls, Hartshill Priory; old stone walls near Arley Village; ruins of Maxtoke Priory.
II. Hasler churchyard! *Purt.* ii., 494; on the West Gate and many old walls in Warwick; on Tachbrook and Stratford Church! *Perry Fl.;* Warwick Castle, 1832. (*Wynch M.S. note in Smith's Flora.*) Salford Priors, on old walls! *Rev. J. C.;* Allesley churchyard wall! *Herb. Perry;* Allesley Village; Kenilworth Castle; Binton churchyard wall; Abbots Salford.

URTICA.

U. dioica, *Linn.* *Common Nettle.*
Native: On banks, waste heaps, field borders, banks, etc. Very common. May to September. Area general.

U. urens, *Linn.* *Small Nettle.*
Native or Colonist: On waste heaps, in gardens, and near villages. Local. May to September.
I. On a bank at Saltley, opposite Coleshill Road, *Ick. Anal.*, 1837; Hampton-in-Arden, *R. Rogers;* near the Royal Hotel, Sutton; waste heaps, near Solihull.

II. Honington; Tredington, *Newb.;* old garden, Offchurch; lane by Brandon Railway Station; Cathiron Lane, near Rugby, on waste heaps.

So far as my experience serves, this plant partakes more of the character of a "colonist" than of a native in this county.

[*U. Dodartii*, garden weed, Saltisford, Warwick; *W. G. P.*, *Herb. Perry.*]

HUMULUS.

H. Lupulus, *Linn.* *Common Hop.*

Native: In hedges near villages, and near old gardens. Locally abundant. July, August.

I. Berkswell, *W. B. Grove;* Driffold Lane, Sutton Park; Tamworth Road, near Moor Hall; Middleton; Marston Green; Shustoke; Elmdon; Hartshill; Withybrook; near old Fillongley Hall; Cornel's End; Bradnock's Marsh.

II. Emscote Bridge, *Perry*, 1817; Tredington! Honington; Halford; *Newb.*, Salford Priors! *Rev. J. C.;* near Kenilworth; etc.

ULMUS.

U. suberosa, *Ehrh.* *Common Elm.*

Denizen or Native: In hedges. Common. February, March. Area general as an aggregate species.

Var. *stricta.* Rare.

1. Coleshill road to Atherstone.

II. Warwick road to Banbury! *H. B.;* near Coventry.

Var. *glabra.* Mill. Rare.

I. Edgbaston Park, *With.* (ed. 7) ii., 358; near Bickenhill! *Herb. Per.*

II. Near Chadshunt, *H.B.* Common about Rugby, *Blox.*, *N. B. G. S.*

Var. *carpinifolia.*

II. Four miles from Stratford-on-Avon on the road to Alcester! *Lindley's Synopsis* (ed. 3), 226.

This appears to be very near *U. stricta* as I understand it.

Var. *major.*

I. Marston Green.

II. Myton; Emscote, *Y. and B.*

This variety has the corky excrescences on the branches strongly developed.

This account of the distribution of these varieties is an unsatisfactory one, attention not having been specially given to this study.

U. montana, *Sm.* *Wych Elm.*

Denizen: In hedges. Local. February, March.

I. By Bracebridge Pool, Sutton Park; Middleton; Shustoke; Packington; Marston Green; Elmdon; Hampton-in-Arden; Solihull.

II. Wixford Lane, *Purt.* i., 138; Milverton, etc., *Y. and B.;* Honington, *Newb.*; Farnborough.

[*Cannabis sativa, Linn.*, occurred as a casual (in some abundance), on railway banks in Sutton Park in 1877.]

AMENTIFERÆ.

QUERCUS.

Q. Robur, *Linn.* *Common Oak.*

Native: In woods, copses, and hedges. Very common. May. Area general.

Var. *sessiliflora*, *Sessile-fruited Oak.* Very local.

I. Edgbaston Park, *With.* (ed. 7), ii., 503.

II. Corley Woods and Hay Woods, *Bree*, *Purt.* iii., 383; Allesley, *Bree*, *Mag. Nat. Hist.* iii., 165; Woodloes, near Warwick; Kenilworth, *Y. and B.*

CASTANEA.

[*C. vulgaris*, Linn. *Sweet Chestnut.*
Alien: In woods and hedges. Rare. May.
I. Westwood Coppice, Sutton Park; apparently *sponte*, coppices near Penns.
II. Ragley Woods; Snitterfield, *Purt.* ii., 462.]

FAGUS.

F. sylvatica, *Linn.* *Common Beech.*
Native: In woods, copses, and hedges. Local. May, June.
I. Hedges near Gravelly Hill; near Dukes Bridge, Maxtoke; Packington Park; Sutton Park.
II. Chesterton Wood, *Y. and B.;* Farnborough; Edge Hills; Compton Verney; Corley.

CORYLUS.

C. Avellana, *Linn.* *Common Hazel.*
Native: In woods, copses, and hedges. Very common. January to March. Area general.

CARPINUS.

C. Betulus, *Linn.* *Hornbeam.*
Denizen: In plantations and hedge-rows. Rare. May.
I. Hampton-in-Arden, *R. Rogers;* two trees in Four Oaks Park, Sutton Park; Doe Bank, near Sutton; Bradnock's Marsh.
II. Several old trees about Ipsley! *T. Dolbar*, *Purt.* ii., 456.
Probably planted in all the stations in Tame basin.

ALNUS.

A. glutinosa, *Linn.* *Common Alder.*
Native: On the banks of rivers and streams, near pools, and in hedges. Common. February, March. Area general.

BETULA.

B. alba, *Linn.* *Common Birch.*
Native: In woods, copses, and hedges. Common. April, May. Area general.
I have not studied the varieties of this tree, so cannot give a satisfactory account of their distribution.

POPULUS.

P. alba, *Linn.* *White Poplar, Abele Tree.*
Alien: In parks. Rare. March.
I. Two trees in Coppice near Moxhall Hall.
II. Binley, *T. Kirk*, *Herb. Brit. Mus.*, 1856; Honington, *Newb.;* Umberslade; several trees in hedges about a mile from Upper Eatington, near the County boundary; Shuckburgh.

P. canescens, *Sm.* *Grey Poplar.*
Native: In hedges. Rare. March.
I. Hullery, near Sheldon, two or three trees; lane to Bickenhill; Marston Green; Erdington.
II. Offchurch; Heathcote, *Y. & B.;* Stoke, *Herb. Brit. Mus.*, *T. Kirk.;* Honington Park.

P. tremula, *Linn.* *Aspen.*
Native: In woods, copses, and hedges. Rather common. March. Area general.
Both the forms occur in the county.

P. nigra, *Linn.* *Black Poplar.*
Alien : Near rivers. Very rare.
I. Curdworth bridge ; near Three May Poles, Shirley.
II. Myton, near Warwick, *H. B.*, *Herb. Brit. Mus.* ; this tree has since been cut down. Rainsbrook, near Barby Road, near Dunchurch, *R. S. R.*, 1877 ; Honington, *Newb.* ; near Moreton Morrell ; near Salford Priors.

(To be continued.)

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

SEVENTH ANNUAL MEETING, AT PETERBOROUGH, 1884.

As the Meeting of the Union took place later in the month than it has done before, we are only able, in the present number, to print the Annual Report. It may be said, however, that the meeting was in every respect a great success. Fine weather and a good attendance rewarded the energetic and well-directed efforts of the members of the Peterborough Society, of whom, among a crowd of hard workers, Mr. J. W. Bodger was conspicuous for his untiring energy and devotedness.

REPORT OF THE COUNCIL.

As the Midland Union of Natural History Societies has now been in existence for seven years, it seems necessary to consider how far it has fulfilled the expectations of its founders, and, if it has in any degree disappointed them, to consider the causes of its shortcomings and how best to remove them. The objects of the Union are thus stated in the first number of the "Midland Naturalist."*

"To extend the usefulness of Local Societies by affording facilities for intercommunication through an authorised and regularly published magazine . . . . . and, by providing opportunities for personal intercourse among the members at meetings to be held from time to time . . . . . to promote the study of Natural History, especially that of the Midland District."

With reference to the first point. Seventy-eight (monthly) numbers of the "Midland Naturalist" have now appeared, and it may be stated without fear of contradiction that these numbers contain a mass of new and reliable information with reference to the Natural History of the Midlands such as is not to be found elsewhere. Local workers who possess complete sets of the magazine will find their value increase as the years roll on. Many faults have been found with this organ of the Union, of which the most common is, perhaps, that its science is not of a sufficiently "popular" nature. The reply to this is that it has always been laid down that the *main* object of such a publication is to be a *record of local scientific facts*. Still, the editors have always endeavoured that the articles should be attractive and readable, as well as accurate and scientific. The amount of original (or other) matter sent in for publication has been far less than was anticipated. Instead of having trouble in deciding what to publish, the difficulty has been to obtain a sufficient supply of matter of a

* Jan. 1878, p. 2

suitable kind. The recent appointment by some of the societies of local sub-editors—charged with the duties of reporting the proceedings of their societies and securing papers for publication—may, it is hoped, remedy this want to some extent.

As to the second object of the promoters of the Union—the bringing together of Midland scientists—it cannot be denied that the Annual Meetings have offered admirable opportunities for those who desired to make the acquaintance of other workers, and that they have done much good in this respect. The meetings have been held at

Birmingham, 1878.	Cheltenham, 1881.
Leicester, 1879.	Nottingham, 1882.
Northampton, 1880.	Tamworth, 1883.

Peterborough, 1884.

Thus the greater part of the Midland district has been covered, and not only have those of similar aims been made acquainted with one another, but such excellent arrangements have invariably been made by the local society or societies of the town in which the meeting was held that in the short space over which the meeting extends—two days—a stranger has been able to see more, and to get a better general acquaintance with the town and district, than would have otherwise been possible. The local programmes, guides, and maps issued to those who attended these meetings are of great interest and value.

It may be said, then, that as far as it was in the power of the Managing Body of the Union the objects of its promoters have been completley fulfilled.

Yet the Council own to considerable disappointment with respect to each of the two main objects of the Union. At its present subscription (to members of the Union) the "Midland Naturalist" is the cheapest scientific periodical issued in England. Yet if it had not been for the action of the Birmingham Natural History and Microscopical Society, which now subscribes for the whole of its members (taking 450 copies), it is to be feared that ere this the magazine would have ceased to exist, so few would have been the number of subscribers.

Then with respect to the annual meetings—how meagre has been the attendance of members other than those belonging to the societies of the immediate neighbourhood of the place in which the meeting was held! It might have been thought that so pleasant and valuable an opportunity of combining science with pleasure would have been looked forward to, and that each meeting-place would have been the rendezvous of at all events a large percentage of those who are really interested in scientific pursuits.

If anything has been brought out clearly by the operations of the Union it is that the number of workers at science in our district who are willing to sacrifice something (if it can be called a sacrifice) for the sake of the general extension and advancement of local science, for which this Union offers such valuable facilities, is extremely small. Very few will even take the trouble to find fault! And of the fault-finders it may be truly said that not one has offered anything in the way of a practical remedy for such faults (imaginary or otherwise) as he may have detected.

It must never be forgotten that "the character of the whole is determined by the character of the parts." When each Society sets vigorously about the task of promoting local scientific research; subscribes on behalf of all, or at least a fair proportion of its members to the "Midland Naturalist," and showers upon the editors pithy notes of its meetings, records of interesting local phenomena, and such papers read before its members as may contain at least a germ of original research; when members of the Union generally show, by their attendance at the annual meetings, that they appreciate the great advantages offered to them at the cost of so much time and trouble on the part of the local workers, then the Union will be pronounced a great success!

But the very fact of the apathy which at present prevails is an argument for the existence of the Union and for the need of more earnest efforts to extend its usefulness.

DARWIN MEDAL.

The Darwin Gold Medal was instituted at the meeting of the Midland Union of Scientific Societies held at Northampton in 1880.

The scheme under which the Medal is awarded states that it is given to the author of the best paper sent in to the "Midland Naturalist" by a specified date; the said paper, or papers, containing evidences of independent and original research on the part of the author. The special subject for which the Medal is awarded varies from year to year.

The previous awards have been:—

1881—Geology, Mr. E. Wilson, F.G.S., of Nottingham.

1882—Zoology, Professor A. M. Marshall, M.A., M.D., D.Sc., and Mr. W. P. Marshall, M.I.C.E.

1883—Archæology, not awarded.

For the present year—1884—the subject was Botany. At a meeting of the Management Committee of the Union, held on April 30th, the Committee proceeded to the election of the adjudicators of the Medal. The five eminent botanists whose names we give below were requested to undertake this duty, and we are glad to state that they individually consented to read and to report upon the papers submitted to them:—Professor C. C. Babington, of Cambridge; Dr. Braithwaite and Maxwell T. Masters, Esq., M.D., of London; W. Mathews, Esq., of Birmingham; and F. T. Mott, Esq., F.R.G.S., of Leicester.

Of the five adjudicators, four agree in awarding the first place to the work of Mr. W. B. Grove, B.A., of Birmingham, to whom the Medal is therefore awarded. The following extracts from their reports may be given:—

In compliance with the request which the Council of the Union did me the honour to make, I beg to say that I have carefully examined all the papers specified.

If it be requisite to single out one in particular, as meriting the award of the Darwin medal, I should select that of Mr. W. B. Grove on the *Pilobolidæ* as specially fulfilling the requirements laid down. In that paper the morphology and life-history of an interesting group of fungi are sketched with a clearness indicative of accurate observation and full perception of the general morphological and genealogical questions involved. Similar remarks apply to the paper on "Nomad Fungi," by the same gentleman, and in which he shows such an appreciation of the present state of our knowledge on the subject as leads him, in some degree, to forecast the probable future classification of these plants. Mr. Grove's paper on the Myxomycetes is marked by the like characteristics. I venture, therefore, to express my opinion that Mr. Grove, on the ground of "independent and original research" as exemplified in all his communications, and particularly in the one first named, has earned a claim to the award of the Darwin medal. MAXWELL T. MASTERS, M.D., F.R.S.

Having regard to the terms under which the medal is awarded, I consider Mr. Grove entitled to it for the "independent and original research" of which there is evidence in his paper on the "Pilobolidæ." WM. MATHEWS.

Mr. Grove has done so much good work for the Union and for the "Midland Naturalist," as well as for the cause of science generally, that it is with especial pleasure that the Council find the high merit of his papers to be recognised by such well-known and independent authorities.

"*Midland Naturalist.*"—Six volumes of this magazine have now appeared. The principal articles published since the last report are: "The Flora of Warwickshire" (continued), by J. E. Bagnall; "Sociology," by W. R. Hughes; "Bats of Oxon," by F. Norton; "Fungi of Birmingham," by W. B. Grove; "Marine Zoology at Oban," by W. R. Hughes; "Holes in the Sand," by F. Enock; "Rhaetics of Nottingham," by E. Wilson; "Summer Migrants," by O. V. Aplin; "Mycological Notes," by W. B. Grove; "The Felspars," by T. H. Waller; "Buckland and the Glacial Theory," by H. B. Woodward; "Glacial Markings in the Red Marl," by A. H. Atkins; "Cremation," by W. H. France; "Flora of Hants," by G. C. Druce; "Biological Analogies," by M. C. Cooke; "Echinoderms," by Dr. Wright; "Ice-grooved Boulders," by W. J. Harrison; "Animal-lore of Shakespeare's Time," by E. W. Badger; "Comparative Anatomy of Teeth," by H. Blandy; "Principles of Biology," by Dr. A. Hill; "Marine Algæ," by Rev. H. Boyden; "Syenites of South Leicestershire," by W. J. Harrison; "Speculations on Protoplasm," by W. B. Grove; "The Recent Sunsets and Sunrises," by W. P. Marshall, M.I.C.E.; "Intercellular Relations of Protoplasts," by Professor W. Hillhouse; "Terns of the Farne Isles," by R. W. Chase; "Note on Lingula Lesueuri," by Thos. Davidson; "The Kimberley Diamond Mine," by W. P. Marshall; "The Heron," by T. V. Hodgson; "Basalt of Rowley Regis," by C. Beale; "*Pilobolidæ*," by W. B. Grove; "Conglomerates of Charnwood," by H. E. Quilter; "Weighing the Earth with a Chemical Balance," by W. J. Harrison, etc., etc., together with the valuable Presidential Address, full of local information, delivered by Mr. Egbert de Hamel at the Annual Meeting at Tamworth. Many local notes, reviews, gleanings, and correspondence have also appeared. In the preparation of the monthly meteorological notes Mr. Clement L. Wragge has been succeeded by Mr. W. Berridge, F.R.Met.Soc., of Loughborough, an excellent and painstaking observer. The editors, Messrs. E. W. Badger and W. J. Harrison, have spared no pains to maintain the character of the magazine for scientific accuracy.

Societies belonging to the Union.—During the past year the Nottingham G. R. S. Naturalists' Society has amalgamated with the Nottingham Naturalists' Society, a change which has been a mutual benefit. The Council regret to have received notice of withdrawal from the Union from the Burton-on-Trent Natural History and Archæological Society, but they trust that the severance may only be a temporary one.

The following is the list of Societies which now form the Midland Union:—

Bedfordshire Natural History Society and Field Club.
Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Burton-on-Trent Natural History and Archæological Society.
Caradoc Field Club.
Derbyshire Naturalists' Society.
Dudley and Midland Geological and Scientific Society and Field Club.
Evesham Field Naturalists' Club.
Leicester Literary and Philosophical Society.
Northamptonshire Natural History Society.

Nottingham Literary and Philosophical Society.
Nottingham Naturalists' Society.
Nottingham Working Men's Naturalists' Society.
Oswestry and Welshpool Naturalists' Field Club.
Oxfordshire Natural History Society.
Peterborough Natural History and Scientific Society.
Severn Valley Naturalists' Field Club.
Shropshire Archæological and Natural History Society.
Stroud Natural History Society.
Tamworth Natural History, Geological, and Antiquarian Society.

Prizes for Scientific Photography.—As an aid to science Photography has come very rapidly to the front during the last few years. In at least two of the Societies in the Union, Photography may be said to attract the greater portion of the energy of the members. By the dry-plate process the art of Photography is rendered so clean and simple that the last few years have witnessed a development of the "art-science" in every direction and a wonderful increase in the number of amateur photographers. The good work which might be done by Photography for science in the truthful rendering of geological sections and scenery, habitats of plants, famous trees, and especially to Biology by micro-photographs, &c., leads the Council to recommend that either one or two Prizes be awarded at each annual meeting of the Union to the best series of photographs of natural history objects exhibited. Such an exhibition would form a great addition to the attractions of the meeting, would be a solid benefit to science, and another incentive to belong to the Union. Copies of the pictures exhibited might be placed in an album which should circulate from one Society to another.

School Museums.—The great improvement in our elementary schools, and the introduction of true "object-teaching," has created, in good schools, a demand for "specimens" and a place to keep them in, which ought to lead to the establishment of school museums—meaning by the term nothing more ambitious than a large cupboard with glass doors above and drawers below filled with a typical collection illustrating local natural history, manufactures, &c. In this work the members of Natural History Societies might render most efficient aid, and the work would be well repaid. In Birmingham such "Museums" are being supplied by the School Board, and Mr. W. J. Harrison will be glad to receive, arrange, and mount any specimens which readers of this report have to spare. Almost any number can be absorbed, as in Birmingham alone there are now thirty Board Schools, attended by forty thousand children.

Young Persons as Associate Members.—In Birmingham, Tamworth, Burton, and elsewhere the plan has been adopted of electing young persons of either sex as "associate" members of the local Society, either free or on payment of a nominal subscription. In this way a kind of "cadet corps" has been formed, from which useful recruits ought to be obtained.

Work of the Societies.—No special features can be recorded during the past year. The Council would strongly recommend that the publications—Annual Report, Transactions, &c.—of each Society should be sent to all the other Societies in the Union. Working in one district and with common aims, it is most important that intercommunication should be as complete as possible. The *Flora of Leicestershire*, on which Mr. F. T. Mott has so long been engaged, is now complete and will, we trust, be speedily published. Mr. Bagnall's

Flora of Warwickshire, which has appeared monthly in the "Midland Naturalist," will also, we trust, be completed during the present year.

As signified last year, Mr. W. Jerome Harrison, the General Hon. Secretary of the Union, now retires from the office which he has filled, more or less continuously, since the formation of the Union. As his successor the Council has much pleasure in recommending Mr. T. H. Waller, B.A., B.Sc., of Birmingham.

In concluding this report, the Council wish to thank the officers and members of the Peterborough Natural History and Scientific Society for the very admirable arrangements which they have made, and the great pains which they have taken to secure the success of the present meeting.

Natural History Notes.

Correction.—In our June number (p. 170) the description of the arrival of large flocks of swallows on the east coast should have been marked as *communicated by* Mr. de Hamel, the actual observation having been made by a friend.

Mr. Herbert Spencer.—Admirers of the synthetic philosophy will be interested to hear that there is a bust of the author in this year's exhibition of the Royal Academy. The Hanging Committee, who seldom give universal satisfaction, appear to have placed the bust in a very appropriate position. It is in the Lecture Room, against the south wall, and is situated between two very graceful compositions of "Ariel," by Mr. Walter Ingram, and a "Portrait of a Lady," by Count Gleichen. The bust of Mr. Herbert Spencer, which is by the eminent sculptor, Mr. J. E. Boehm, R.A., is of terra cotta, and although, from the nature of the material, it is somewhat "sketchy," it must be regarded as a very admirable likeness, although it lacks—as all conceptions of this nature unavoidably lack—that sunniness which brightens and animates the countenance of the Master when in conversation. It is to be hoped that copies of the bust of a smaller size will be published so that Mr. Herbert Spencer's many friends and admirers may obtain this interesting souvenir. There is also a most effective bust of Darwin, by Mr. Robert Stark, in the same exhibition.—W. R. H.

METEOROLOGICAL NOTES.—May, 1884.

The barometer was inclined downwards at the commencement of the month, and continued to fall until the 4th, when it reached its lowest point, 29.250 inches, at 8 A.M., after which it rose rather rapidly to the 10th. After a fluctuating movement, it again rose rapidly to 30.450 inches, on the 22nd, thence falling in an undulatory manner to the end of the month. Temperature was decidedly low until the 8th, when there were a few warm days, maximum readings of 76° or upwards being registered on the 11th. The sheltered thermometer attained a maximum of 79.5° at Loughborough, on the 23rd; on the 29th the highest reading was only 52.9°. Some low temperatures were registered on the grass—26.1° at Hodsock on the 27th; 24.8° at Strelley on the 1st; and 24.5° at Loughborough on the 21st. Rainfall was considerably under the average, the totals for the month being 1.20 at Coston Rectory, 0.89 at Strelley, and 0.84 at Hodsock and Loughborough. The latter portion of the month—after the 15th—was absolutely "rainless," and the protracted drought was injurious to the herbage, though heavy dew on some mornings counteracted it in some measure. A lunar halo was observed on the 1st, thunder was heard on the 5th, and lightning was seen on the evenings of the 12th and 24th. Sunshine was rather deficient. Westerly breezes were prevalent till after the middle of the month, light north-easterly air towards its conclusion. WM. BERRIDGE, F.R.Met.Soc.

12, Victoria Street, Loughborough.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION, June 10th.—Mr. W. H. Wilkinson exhibited *Equisetum sylvaticum*, *Saxifraga oppositifolia*, *Salix reticulata*, *S. herbacea*, *Symphytum tuberosum*, and other plants from Scotland. Mr. Bolton, larva of a star fish in the bipinnaria stage. Mr. Levick reported that two old and esteemed members of the Society, Mr. Saville Kent and Mr. J. W. Pickering, had sailed a fortnight ago for Australia in the ship "John Elder." Mr. W. J. Harrison announced that the Darwin medal was adjudicated to Mr. W. B. Grove. Mr. R. W. Chase then read his paper "On a visit to the Norfolk Broads." He first described what a Broad is—a kind of inland lake—sometimes traversed by a river or supplied by underground springs, or in a few cases affected by tides. They are the haunts of our rarest birds, though now being encroached upon to a very serious extent. He gave an account of the birds which he saw, such as great crested grebes, swans, bearded tits, yellow wagtails, redshanks, lapwings, garganey teals, shovellers, water rails, black-headed rails, moor hens, mallards, etc. He also described the working of a decoy, such as that which will be exhibited to the members of the Midland Union during their visit to Peterborough. MICROSCOPICAL GENERAL MEETING, June 17th, 1884.—Mr. W. R. Hughes presented, on behalf of Mr. F. W. Sharpus, of London, six slides illustrating the larval stages in the development of the Echinodermata (*Echinopædium*, etc.) prepared by the students of the Zoological Station at the Naples Aquarium. Mr. J. E. Bagnall exhibited *Callitriche stagnalis* in fruit, and a moss, *Sphagnum squarrosum*, in fruit—the first time this has been recorded in fruit from Warwickshire—*Potamogeton polygonifolius*, *Myriophyllum spicatum*, and *Ranunculus circinatus*, all from near Meriden. Mr. T. Bolton exhibited a new rotifer *Notommata spicata*, also another rotifer supposed by Dr. Hudson to be *Ptygura melicerta* of Ehrenberg, both from Sutton Park, and a worm, *Nais hamata*, a species described as new last year in a German periodical. Mr. A. Pumphrey then gave an interesting paper on the effects of the recent earthquake in the eastern counties. He first described the wave-like motion of earthquakes generally, then some of the modes of ascertaining the force and direction of the shock. Next he gave a graphic description of the recent earthquake in Essex, describing the damage done to the Congregational Church, Colchester, the Rose Inn, and the porch of the church, Peldon, the church at Langenhoe, etc. The paper was illustrated by a series of photographs taken on the spot a few hours after the event, shown by the oxy-hydrogen lantern. The views added much to the interest of the paper, and were duly appreciated by the audience. He afterwards showed a number of striking and life-like photographs of animals and human beings, all taken by the instantaneous process. SOCIOLOGICAL SECTION.—On Saturday, June 14th, thirty-nine members and friends made the summer excursion of this section to "Landor's Country" (Warwick). The weather was extremely fine. Interesting visits were paid to Warwick Castle, Leycester's Hospital, and Landor's birthplace; and after a bountiful meal a most charming account of Walter Savage Landor and his writings was read by Mr. Howard S. Pearson. This crowning pleasure was followed by a few short speeches and votes of thanks, which were crowded in before the train time for returning. On the following Thursday, at the ordinary meeting of the Section, the study of Mr. Herbert Spencer's "Principles of Biology" was resumed, the important chapter on Genesis receiving an interesting and instructive exposition from Mr. W. B. Grove, B.A.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 19th.—Mr. J. Betteridge read a short paper describing a day's ramble from Birmingham, with a list of sixty-two birds seen on the way, with remarks on the same. At the close of the paper the writer exhibited nest and eggs of sparrow hawk (*Accipiter nisus*) and specimen of long-tailed tit (*Acredula rosea*) with nest and young. Mr. Madison, *Limnæa peregra* var. *labiosa*, from Acocks Green. Under the microscopes, Mr. Tylar showed *Heliopelta euleri*, Mr. J. W. Neville leaf of *Drosera rotundifolia* with captured insects, Mr. Hawkes eggs of alder fly, Mr. Insley sori of bracken fern and fossil sori in section of elland coal. May 26th.—Mr. Betteridge exhibited specimens of grey wagtail in summer and winter plumage, also nest and eggs of great crested grebe (*Podiceps cristatus*). The subject for the evening was Special Botany—microscopical fungi. Mr. Deakin showed a large number of dried and mounted specimens; Mr. Hawkes the following freshly gathered ones:—*Æcidium ari*, *Uredo confluens*, *Uromyces intrusa*, *Puccinia malvacearum*, etc. Under the microscopes, Mr. Deakin showed *Xenodochus carbonarius*, Mr. J. W. Neville *Aregma bulbosum*, Mr. Hawkes *Æcidium urticæ*. June 9th.—Mr. Moore exhibited nests of mason bee (*Anthophora acervorum*) and the perfect insects, also ruby-tail flies (*Chrysis ignita*) reared in the same nests and sometimes called from this fact cuckoo flies. Mr. Madison, lead ore and other minerals from Isle of Man, also the following shells:—*Helix aspersa* var. *tenuis*, *H. nemoralis* var. *arenicola*. *Ancylus fluviatilis* var. *albida*, and *Limnæa truncatula* var. *elegans*. Mr. J. Turner, a portion of the lightning conductor of Francis Road Chapel, showing the effects of the previous day's storm; the wire had been partly fused, and was twisted into a spiral form. The following objects were shown under the microscopes:—Mr. Dunn, nais worm; Mr. Tylar, pedicellaria of Echinus; Mr. J. W. Neville, head plate of Megalicthys from Lancashire coal beds.

THE PRESERVATION OF NATIVE PLANTS.

BY A. W. WILLS.

Some time ago I brought before the members of the Birmingham Natural History and Microscopical Society the subject of the reckless Vandalism which threatens many of our native plants with speedy extermination, and the subject having been referred to the Committee, Mr. W. R. Hughes, F.L.S., and myself were deputed to attend the recent meeting of the Midland Union at Peterborough in order to urge upon the Council the importance of taking such steps as might appear practicable in order to arrest, if possible, the progress of this destruction.

The pressure of business prevented my laying our views before the Council in detail, and I therefore avail myself of the columns of the "Naturalist," kindly placed at my disposal by the Editors, to place them before the members of the various Societies comprised in the Midland Union. Meanwhile I am glad to say that the Council pas ed two resolutions: the one expressing sympathy with the object which we have in view, the other directing the Management Committee to consult with us as to the means by which this object may be best compassed.

Since I determined to bring this subject before the Birmingham Society my attention has been drawn by the Rev. C. Wolley Dod, himself well known as an ardent lover of Nature and as a skilful grower of hardy plants, to the fact that the naturalists of Switzerland, alarmed by seeing the like Vandalism rampant among their beautiful mountains and valleys, have formed a Society, the objects of which are indicated by its name—"Société pour la Protection des Plantes;" and as the evil which they seek to combat has its origin in causes similar to those which prevail among ourselves, I cannot give a definite shape to our views better than by claiming your attention to a brief summary of certain points set forth in the report of the first year's work of this Swiss Society.

First, then, the ravages of the paid or professional plant-hunter are described in passages from which I take the following:—"Among all the species of Orchidaceous plants formerly to be found at Zofingue there remain only three, and these among the commonest. A single man has destroyed all the rest; an individual who made a trade of collecting plants for the use of druggists. Some botanists were imprudent enough not only to employ him as a porter, but even to point out to him which were the most beautiful and rarest plants. This man perfectly grasped how this information might be made subservient to his own interest, and now he brings these plants down every spring by basketfuls, roots and all, and sells them to amateurs for their gardens."

Need I draw a parallel between this process and that which is going on daily in our midst? or remind you of the professional British plant-hunter, who haunts the popular resort of the tourist and during the holiday season purveys the most beautiful or rarest flowering plants and ferns of his district, ruthlessly eradicating them in the height of their summer growth? When I was in the habit of visiting North Wales frequently in my earlier years, sheets of Oak Fern carpeted the soil beside almost every waterfall; the glorious Osmunda grew in profusion in some of the marshy flats of Carnarvonshire; I could always find *Polystichum Lonchitis* by an hour's search in certain habitats; *Asplenium septentrionale*, though scarce, grew in one or two localities in considerable quantity; and the rarer *Woodsia ilvensis* was to be found in stations known to the few who were familiar with the recesses of Cwm Glas or the crags of Clogwyn-y-Garnedd; while *Anthericum serotinum* and other choice flowering plants equally rewarded the search of the industrious botanist.

Now the rarest of these are extinct or all but extinct. The lovely Royal Fern is extremely scarce, and the Oak and the Beech Fern have been well-nigh exterminated, and such comparatively common species as *Asplenium viride* among ferns, and the exquisite *Silene acaulis* among flowering plants, are difficult to find.

The same process has been going on in every other district frequented by the tourist, and every botanist could furnish a list of plants which, during the last twenty years, have been exterminated or made scarce by the ravages of the trade collector.

Again, in the markets of our own and of other large towns even the commoner plants of the district are daily exposed for sale by hundreds, usually in full leaf or flower, so that the lanes and hedgerows for miles round are completely stripped, and even the Daffodil and the Male Fern have become scarce.

Then look for a moment at these advertisements, culled from the columns of periodicals devoted to horticulture, which it is impossible to read without a feeling of disgust and indignation:—

24 DEVONSHIRE FERNS, named varieties, for 1s. 6d., larger plants 6d. extra. Maiden-hair (Asplenium Trichomanes), black

Maiden-hair (Asplenium Adiantum nigrum). Plants with good crowns and roots and instructions, 1s. per dozen. All securely packed in strong box, post free.—J. O., Barnstaple.

FERNS from Devonshire, Cornwall, and Somerset. Fourteen named varieties, 6s. per 125; parcel post, thirty good plants, 2s. 6d. Two choice FILMY FERNS (Hymenophyllum tunbridgense and unilaterale), 2s. per root, free.—E. G., Lodging-house Keeper, Lynton, Devon.

WYE VALLEY FERNS, 7s. 6d. hundred; 4s. fifty; 2s. 3d. twenty-five. Primroses, 3s. fifty; free.—A., Tyersall, St. Breavels, Coleford.

CELEBRATED KERRY CAVE FERNS.—Twelve assorted roots, 1s. 4d.; thirty-six, 3s.; 100, 8s.; free.—F. P., Rathanny, Tralee, Kerry.

PRIMROSES for spring bedding, every root warranted healthy and strong; price, 1s. 3d. for fifty; 2s. per 100; 10s. per 1,000; if sent free by parcels post, 3d. per fifty extra.—T. P. M., Horncastle.

HARDY BRITISH FERNS, very strong clumps, 2s. 6d. dozen; Scolopendrium vulgare (Hart's-tongue Fern), 1s. 6d. and 2s. 6d. per dozen.

And another, which I have unfortunately mislaid, offers choice wildflowers from Cheshire, among which primroses figure at 5s. to 15s. per 1,000; *Orchis mascula* at 5s. per 100; *Orchis maculata* and *Saxifraga granulata* at 2s. 6d. per 100; and that gem among marsh-plants, the Bog Asphodel, at 2s. per doz.; while, in conclusion, tenders are invited for *half a million of Daffodils* for autumn delivery!

Reverting to the Report of the Swiss Society, we find another cause of extermination indicated thus:—"Often a master with his pupils or a professor with his students, making a botanical excursion, arrives at a habitat of rare plants. Each one helps himself freely, even profusely, without thinking that in this fashion the species will rapidly disappear." And again, referring to the researches of the ordinary collector: "Many botanists are in the habit of taking too large a number of specimens of rare plants, without reflecting on the consequences of this act of Vandalism."

Finally, the operation of Exchange Clubs is illustrated by the experience of a member of the same society who applied to one of them for assistance in filling up certain gaps in his herbarium, and was in reply asked to enter into an active exchange of specimens. A long list of the rarest plants was sent to him, with the request to supply "100 fine plants with roots," "as much as possible, whole plants with buds, fruit, &c.," while of several species he was asked to forward "a cart-load." Putting the "cart-loads" on one side and reckoning 100 as the equivalent of "as much as possible," in all over 5,000 specimens were required. As the writer remarks, "There is something to make one's hair stand on end in such a list," and it is to be remembered that as there are two parties to such an exchange each transaction represents the wholesale spoliation of two habitats; and also that a species of which even the flowers only are constantly gathered forms no seeds and is doomed to more or less speedy extinction.

Having thus indicated the chief causes of extermination, which are alike in every country, let us consider if any means are available to check its disastrous progress.

Probably it will be conceded that restrictive legislation or police interference is inapplicable, even if it were desirable. Yet we would suggest that wherever tracts of country are under the control of private persons or of specific local authorities, their assistance might be invoked to prohibit the promiscuous gathering of flowers, or at any rate the removal of roots.

The Swiss naturalists have concluded that the best means of checking the trade in plants torn from the mountains is to raise them in the plains and so put them on the market at rates which will make the trade unremunerative, and for this end they have taken a large nursery at Geneva, the results of the experiment being so far considered very satisfactory.

But the flora of Switzerland is more abundant and more special than our own, while Geneva is a natural centre where the botanical visitor is brought face to face with the condensed epitome of the flora which is the object of his interest. We doubt, therefore, whether a similar mode of proceeding would prove effective here. Yet it would doubtless contribute to *some extent* to the preservation of our flora, so far as its extermination is a consequence of the desire to form collections of native plants, although it would form no barrier to the rapacity of the ignorant tourist, if the extravagant prices which one has now to pay were reduced, as they certainly might be in the case of all species easily propagated by subdivision or raised by seeds.

It is, however, by the *indirect influences of example and persuasion*, and by the *promotion of healthy public opinion*, that much more is to be effected.

In the words of the Report on which I have based my remarks, "Teachers and professors might effectually second us by inculcating upon their pupils the idea of the protection of rare plants, and by calling their attention in their botanical courses to the grievous consequences of this destruction, alike for science and even for the pleasures of the vulgar profane, by teaching in one word respect and love for Nature." And again, "Botanists should reflect more seriously on the inevitable consequences of a hasty and immoderate gathering of plants."

It is unnecessary, in appealing to a body of naturalists, that I should dwell further on these points. I beg, therefore, in conclusion, to suggest certain practical measures which we intend to ask the Management Committee of the Midland Union to carry out by such means and with such modifications as their wisdom may suggest.

First, then, we think it would be a graceful act if they expressed the sympathy of our Societies with those Swiss naturalists who have, to use their own words, set before themselves an object only to be attained by many years of persevering labour, by passing a resolution pledging our members to contribute, by all means in their power, to the cause of the preservation of the native flora of that glorious land which has been the resort and the delight of so many of themselves and of their countrymen.

Next, we shall ask the Committee to pass resolutions expressing indignation at the Vandalism by which so many of our own native plants are being exterminated, and pledging the members of every Natural History Society and Field Club in Great Britain to use strenuous efforts to oppose this destruction, and setting forth that the best means of doing so appear to be—

1. To induce all teachers and professors of botany to impress upon their pupils the deplorable consequences of the careless and indiscriminate gathering of rare plants.
2. To pledge all members of Natural History Societies, Field Clubs, and the like, to abstain from gathering more than the smallest number of specimens necessary for their own studies, and from taking roots or seeds of rare species; to refuse to become members of or to supply specimens to Exchange Clubs; and to refuse to buy plants from or directly or indirectly to encourage professional hunters of plants which are *either locally or absolutely rare.*

Lastly, we shall suggest that these views should be embodied in a concise statement, which shall be published in the "Midland Naturalist;" that steps be taken to procure its insertion in the journals of all such societies as have their own local organs; and that copies be sent to all Natural History and similar Societies in the kingdom, to the Council of the Alpine Club, to the Editors of "Nature," of the journals devoted to Horticulture and to Natural Science, and of the principal London and provincial newspapers and periodicals, and to such other publications as the Committee may think desirable, with an appeal asking the Editors or Managers of the same to assist in creating a powerful and healthy public opinion on this subject.

We feel that such an effort as we are advocating cannot be altogether barren of good results, although it may not effect all that we could earnestly desire, and that it will redound to the lasting credit of the Midland Union to initiate a movement the scope and object of which are so large and so important.

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 187.)

h.—The Dewdrops.

We have thus traced our Pilobolus nearly to the stage in which it was depicted in the opening remarks. It is now mature and ready to disperse its spores, but before proceeding to consider that interesting process it will be well to advert here to a few minor points connected with its growth. One striking phenomenon, which has arrested the attention of all observers of Pilobolus since its first discovery, is the appearance on the stem of what are called "dewdrops." Little round drops of a clear fluid, one, two, three, but often twenty to thirty in number, are seen adhering to the growing stem, in all stages from its first formation up to the completion of the swelling (Fig. 18), in the same way as drops of dew adhere to blades of grass and spiders' threads. As Cohn says, we must suppose either that they are deposited on the outside by condensation of watery vapour from the surrounding atmosphere or excreted through the cell membrane as a superfluous product of the fungus itself. The dewdrops are unusually abundant on Pilobolus when growing in a damp locality, and we can observe similar drops deposited on withered stems of Mucor and other objects in their neighbourhood, so that probably in a saturated atmosphere some of the drops spring from that source. But that they do not all arise in this manner is manifest, when it is observed that the drops are long maintained, or even originated, in situations in which the condensation of atmospheric vapour would be impossible, as, for instance, while the specimens are being examined beneath the microscope in the concentrated beam of the lamp. In fact, if a single specimen removed from its matrix be watched in such a position, it will be observed speedily to become dry and withered; but if a vigorous individual be taken, with a certain quantity of the moist substratum attached, the drops will easily maintain themselves, thus showing that the supply is kept up from the interior of the Pilobolus stem, which again derives it from the mycelium.

But the liquid is not pure water; it has a greater refractive index, resembling that of the cell sap which occupies the axis of the fungus, and it contains dissolved in it the same crystalloid substance which we know the cell sap to contain. When the drops adorning the exterior of a Pilobolus become dried up, they often leave behind on the surface a number of minute, angular, transparent, crystal-like bodies, which are apparently identical with mucorine. The cause of this excretion of course lies in the upward pressure of the contents of the stem, which drives a little of the more fluid material through the cell walls.

The dewdrops occur on every part of the stem and swelling, and also in the angle between the latter and the sporangium, but very rarely on the sporangium itself. Moreover, when an individual is placed, as above described, in the concentrated beam of the microscope lamp, the sporange, though intact, speedily becomes shrunken and the cap puckered and depressed, while the swelling retains its fulness if it finds a sufficient supply of moisture from beneath. These facts show, what we have already found reason for believing, that there is very little communication between the sporangium and the stem, after the septum is once formed.

The earlier writers on Pilobolus were much struck with this phenomenon, and indeed few objects can be conceived more beautiful than a well-grown specimen thus bedecked with pearls of dew. One of the species, *P. roridus*, obtained its name from being pre-eminently thus adorned; but the dewdrops are to be met with in every species. And it is not a pretty sight only, but, as it seems to me, has a direct bearing upon the now important question of the porosity of the cell-wall. For the process would appear to be not an inter-molecular diffusion, but an actual passage of fluid through minute canals piercing the membrane; and it must be remembered that, so long as the supply from beneath is kept up, the turgidity of the stem and swelling continues unimpaired.

Otto F. Müller, in 1778, announced the discovery of a new species of zoophyte, in the true meaning of that word. He had met with some specimens of Pilobolus, in the midst of which he thought he saw a slender worm-like body residing, which, as he says, "crawled round in the crystal globe, and seemed to swim at its ease in a tiny ocean." The worm-like body was undoubtedly a species of Anguillula, such as are very common on the same habitats which Pilobolus affects; but how he conceived it to be within the globe is hard to say. These little Anguillulæ will penetrate wherever there is moisture; they may often be found crawling over the stem or sporange, and in many of the dew-drops which adorn the stem. It is amusing to watch them in such a situation, twisting themselves in incessant snake-like contortions in a sphere of liquid of diameter scarcely equal to their own length. When seen with a lens of low magnifying power it might be thought that the animal was within the swelling of the Pilobolus. Moreover, a stem which has not yet formed its sporange sometimes excretes the watery fluid which constitutes the dew-drops in such quantity at its very apex as to form a large transparent globe (Fig. 2), which might, at a hasty glance, or with only rough means of amplification, be taken to be a part of the plant; a stem which has projected its sporange sometimes, though more rarely, does the same; in these globes the Anguillulæ are often seen. Durieu de Maisonneuve and Léveillé both also believed that they had seen the worms within the plant. But other observers have always denied the fact, and it is plain that the error arose from the use of insufficient magnifying power. A specimen sent to Van Beneden by Coemans was determined to be *Rhabditis terricola*, Dujardin, but more than one species occurs in this way. Coemans also found certain Infusoria, which he figures,* on the outside of a Pilobolus, but these I have not met with.

i.—The Basal Reservoir.

The basal reservoir of Pilobolus is usually of a roundish form (but in one species almost cylindrical), and presents a very different appearance according as it is sunk in the matrix or elevated above it. This arises from the fact that, even after the stem has grown up to maturity, there still remains a great quantity of yellow granular substance in the reservoir,

* Monographie, pl. ii., fig. D.

which attracts attention by its golden colour, and so the aspect of a group of the plants is perceptibly different, according as the reservoir is visible or not. While exceptions of course occur, it will yet be found that its position is pretty constant for each species, and one of the British species is recognisable by the naked eye, on account of the brilliant yellow colour which it presents, owing to its basal reservoirs being mostly above the matrix. The reservoir is not always terminal, as it is usually in *P. Kleinii;* in the species identified with Bolton's *Mucor roridus*, the *P. roridus* of Persoon, and *P. microsporus* of Klein, both the latter author and Van Tieghem found the reservoir most often intercalary—that is, placed in the course of the mycelium, with a mycelian apophysis on each side. In Van Tieghem's *P. nanus* there were found two, three, or even five such placed contiguously. It sometimes occurs so also in *P. crystallinus.*

j.—Dehiscence of the Sporange.

We will now proceed to consider more closely the ultimate fate and projection of the sporange. In the first place, let me say that the earlier observers completely misunderstood the mechanism by which this is effected. There are really two phenomena to be studied, the dehiscence of the sporange and its projection. I have described how the upper portion of the wall of the sporangium becomes black and cuticularised; this thickening process stops rather abruptly along a circular line a little below the equator of the sporange, so that the "cap" extends over a little more than a hemisphere. The narrow zone lying between this circle and the circle of insertion of the columella not only is not thickened, but becomes thinner and more fragile, and at last possesses in a conspicuous degree that property, characteristic of the membrane of many Mucorine sporangia, of breaking up into minute particles on the application of water, to which the name of *diffluence* is given. The hyaline interstitial substance, in which the spores are embedded, extends beyond the spore-mass, so as to occupy a portion of the interval between it and the wall of the sporangium. It does not, however, in the normal state, quite come into contact with the wall, at any rate in the lower portion, where moreover this peripheral layer is thicker than it is beneath the "cap" (Fig. 8). When the sporange is mature, the application of a drop of water to the diffluent zone causes it immediately to disappear, the edges of the black cap curl up a little, and the gelatinous substance greedily imbibes the water, and swells up more or less. I have mentioned how frequently one or two "dew-drops" are found to occupy the angle between the swelling and the sporangium, and it is doubtless by this means that the dissolution of the diffluent zone is effected in a state of nature. We can often meet with the sporangia in this condition; it is then easily seen that the spores are not enclosed as they were before, except by the gelatinous substance. The black cap now lies loosely perched on the top of the spore-mass, and can be lifted off with the point of a needle, like a glove drawn off a finger. It frequently becomes puckered round the free edge and assumes a more or less angular outline (Fig. 5). When the ripe sporange is placed on a slide with abundance of water, the gelatinous substance swells up more than in the natural state, protruding beyond the cap in a characteristic manner, as shown in Fig. 5.

k.—Projection of the Sporange.

The sporange has now dehisced, and the spores may escape by degrees. But in order to secure their wider dissemination the sporange is usually projected to a distance with considerable force. This projection may take place before, but usually follows after the dehiscence. The continued upward movement of fluid and protoplasm into the swelling of the stem, which was the cause of its formation, at last produces so great a tension of the walls that they give way at the point of greatest strain. It is easy to see that this will be along the circle of insertion of the columella or thereabouts. Just below this the rupture takes place; the walls of the swelling contract slightly, the tension being relaxed; the contained fluid is spirted out, bearing with it the columella and the sporangium seated thereon. The movement is accompanied by a faint but distinctly audible "puff," like the sound of a minute pop-gun. The distance to which the sporange may be thrown varies according to circumstances from a few inches to several feet. If the Pilobolus be grown beneath a bell-glass the interior surface of the glass will be covered with the sporangia. Coemans records that they can be projected to a height of over three feet.* I have myself grown *P. œdipus* beneath a glass shade, twelve inches high, and found sporangia adhering to it on all sides to the very top.

Once while I was examining a tuft with a lens I heard a faint sound proceeding from another tuft six inches off, and at the same instant felt myself struck near the middle of the

* Monogr., p. 39.

forehead; the blow was accompanied by a sensation as if a tiny drop of water had fallen there. On looking in a glass I could see the little black sporange adhering where it struck, and it remained there for several hours. I immediately took the patch of *P. Kleinii* from which it came (and I should mention that the stems of these specimens were bent almost at a right angle under the influence of the one-sided light beneath which they had grown) into an empty room, where I placed it with the upper portions of the bent stems pointing towards the window. I then laid a number of sheets of white paper around it, and in the same horizontal plane; carefully closed the door and left it for an hour. This was just about midday. On returning I found all the sheets covered with a multitude of black dots, which a lens revealed as the sporangia; each sporangium was surrounded by a brownish stain, produced by the liquid ejected at the same time. On measuring the distances to which the sporangia were thrown I found that a majority lay between three and four feet, but nearly a score lay at a greater distance than four feet, and the farthest I could find at a distance of 4ft. 10in. When we consider that the utmost height of the individual fungi from which these bomb-shells proceeded did not exceed one-tenth of an inch, and that therefore the last-mentioned sporangium was thrown to a distance of nearly 600 times the height of the plant which threw it, we can form some idea of the enormous force exerted in this instance. It is as if a man of average height were able to throw his own head to a distance of nearly two-thirds of a mile.

We may mention a few other instances known amongst Fungi of a projectile force, without referring to those which exist in Phanerogams. Chordostylum and Caulogaster, which are by Corda erroneously classed with the Pilobolidæ, project their sporangia, and so do Sphærobolus and Thelebolus. The spores of Empusa are elastically projected from their basidia, when mature, and accompanied by a little of the protoplasmic contents, as in Pilobolus. According to Zalewski the spores of various species of Œcidium are thrown vertically from their cups to a height amounting in favourable cases to 10-20 mm.* The spores also of many Discomycetes, Ascobolus, Peziza, Morchella, Vibrissea, etc., are violently discharged into the air by the rupture of the containing asci.

A curious circumstance, which has often been noted with wonder, is that the projected sporangia are nearly always found to be attached to the object upon which they alight by

* Inaugural Dissertation delivered before the Kaiser-Wilhelms Universität, at Strasburg, 1883.

their lower surface. I think that nearly every one which was to be found on the pieces of paper placed to receive the sporangia in the experiment narrated in the last paragraph but one, was in that position; and it is so certainly with all which cling to the interior of the bell-glass. [Bell-glass and paper exhibited.] But there are exceptions when they fall on a rough surface, and it is easy to see the reason of this when we remember the dehiscence previously mentioned. The upper surface of the sporangium is round and practically smooth (though not actually so), and the lower edge and face are occupied by the gelatinous substance. Now, when a sporange is thrown upwards it will certainly rotate as it flies; if the smooth top only comes in contact with the glass (or other vertical surface) it will not adhere, and the sporange will fall down again. But, if any portion of the gelatinous substance touches the glass, the force of progressive attraction* between it and the thin film of moisture which will usually cover the glass must invariably bring the lower, somewhat plane, surface of the sporangium into close contact with the glass. In the case of the paper, the sporangia would naturally roll over, if they fell on the convex surface, and settle on their lower face. But if they fall on the uneven surface of the dung on which they grow they may be found in all positions, even bottom upwards.

The stem from which the sporange has been projected remains for a short time still standing, and in that condition we can easily see the circular aperture at the top from which the columella was torn away (Fig. 11). We may sometimes find a stem without its sporange, but still retaining its columella; it would be a mistake, however, to suppose in this case that the sporange had been violently thrown off. It may have been accidentally removed in the manipulation of the specimen; it may have been, as Klein suggests, shot off by another passing sporange; but usually, I believe, the occurrence is to be explained by the so often mentioned phenomena of dehiscence. If an abundant supply of moisture be present the gelatinous substance swells up to an enormous extent, and the spore-mass, being then only lightly perched upon the conical columella, would obviously be liable to fall off by its own mere weight, unless it were very accurately balanced. Klein remarks that, when this has taken place, he has frequently seen the columella alone afterwards projected by the ordinary explosive action.

* See Dr. R. Norris's Experiments in the Proceedings of the Birmingham Natural History and Microscopical Society, 1869, p. 36, pl. viii.

(To be continued.)

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(*Continued from page 201.*)

AMENTIFERÆ (*continued*).

SALIX.

S. pentandra, *Linn.* *Sweet Bay-leaved Willow.*
Native: In moist woods, hedges, and sides of rivers. Rare. April to July.
I. Five trees on the canal side, near Bromford Forge; Holly Lane, near Balsall Street; Pool Hollies, Sutton Park; Meercote Mill Pool, near Berkswell.
II. Binley, near Coventry, *Bree;* on the banks of the Avon, near Holbrook Grange, *Purt.* iii., 71, near Alderminster, *Lees. Bot. of Worces.*, 1867; Honiley! *Y. & B.;* Arbury, *Kirk, Herb. Perry.* Marshy coppice, near Farnborough.

S. fragilis, *Linn.* *Crack Willow.*
Native: In woods, hedges, and on river banks. Common. April, May.
I. Sutton Park; Witton; Curdworth; Hartshill; Over Whitacre, &c.
II. Whitley! *Kirk, Herb. Perry;* Myton, near Radford Semele, *H.B.*; Brinklow! *Kirk*; Honington, *Newb.*; Farnborough; Little Alne; Wootton Wawen.
b. decipiens, Hoffm.
Alien: In hedges and osier grounds. Rare. May.
I. Meriden Marsh.
II. Quinton Pool, near Coventry, *Kirk, Herb. Perry;* Myton! *H.B.*, *Herb. Brit. Mus.*; near Kingswood Station, in osier ground; near Great Alne, in hedges; Henley-in-Arden.

S. viridis, *Fries ?*
b. Russelliana, Sm. *Bedford Willow.*
Native or Alien: Near rivers and ditches. Local. April.
I. Near Sutton Park.
II. Milverton! *Y. and B.;* Pinley! *Kirk, Herb. Brit. Mus.;* Stoke Heath; Fillongley, *Kirk, Herb. Perry.*, Emcote, *H.B.;* near Myton; Alveston Pastures.

S. alba, *Linn.* *Common White Willow.*
Native: Near rivers and in hedges. Rather common. April.
I. Witton; Copt Heath, near Knowle; Arley; Knowle; Honiley, &c.
II. Pinley and Whitley! *Kirk, Herb. Per.*, Honington, *Newb.;* Warmington; abundant near Great Alne; near Newbould-on-Avon; near Flecknoe.
A common tree in some parts of the county, but very local in others.
b. cærulea, Sm. Rare.
II. Brandon, *Kirk, Herb. Perry;* Avon side, Emscote; near Walton village, *H.B.;* Myton *Y. and B.;* Sowe Waste; near Honiley; lane Bearley to Little Alne.
c. vitellina, Sm. Rare.

II. Meadows near Myton, Warwick, *H.B.*, *Herb. Brit. Mus.;* Coventry Park, *Kirk*, *Herb. Brit. Mus.;* near Kingswood Station; Lapworth Street, near High Chimneys; near Great Alne; lane from Bearley Cross to Preston Bagot.

S. triandra, *Linn.* *Long-leaved Smooth Willow.*
Native: In woods, hedges, and banks of rivers. Rare. April.
I. Olton Pool.
II. Osier holts, near Alcester; at Broom Ford, close to the river, Wexford Bridge! *T.P.*, *Purt.* iii., 73; Wyken Rumps, *T. Kirk*, *Herb. Perry;* Radford Semele, near Leamington! Myton; Old Park, Warwick; Chesterton Mill Pool, *H.B.*
b. Hoffmanniana, Sm. Rare.
II. Banks of the Leam, Radford Semele! *H.B.*, *Herb. Brit. Mus.;* Myton; Stockton, near the canal; Tachbrook! *H.B.*, "Frequent about Rugby," N.B.G.S.
c. amygdalina, Sm. Rare.
I. Bickenhill, *Y. and B.*, near Hampton-in-Arden; Hill Bickenhill; Olton Pool; near Freasley Hall, Tamworth.
II. On the banks of the Arrow and Avon; and in osier beds in several places near Alcester, *Purt.* iii., 73; Sowe Waste; near Coventry, *T. Kirk*, *Herb. Brit. Mus.;* Leam! near Leamington, *H.B.*, *Herb. Brit. Mus.;* Wyken, *T.K.*, *Herb. Perry;* Quarry Lane, Rowington! *H.B.;* Lowsoms Ford, near Lapworth.

S. purpurea, *Linn.* *Bitter Purple Willow.*
Native: Banks of streams and pools. Rare. March, April.
b. Woolgariana, Bor. Very rare.
II. Shrewley Pool, near Hatton, *H.B.* ! (female).
c. Lambertiana, Sm. Rare.
I. Olton Reservoir.
II. Salford, Wixford, *Purt.* ii., 744; Shrewley Pool, *Dr. R. L. Baker*, *Ex. Club Rep.*, 1879; Myton! marsh near Radford Semele! *H.B.*

S. rubra, Huds.
Var. *c. Helix?* Linn. *Rose Willow.*
Native: In hedges, sides of rivers, and osier beds. Rare. April, May.
I. Olton Reservoir.
II. Dunnington, *Purt.* ii., 473; Myton! Beausale, *Y. and B.*; Counden (near Coventry) *T.K.*, *Herb. Perry.* Meadows near Leamington; bog at the Woodloes! Brownslow Green, near Hatton! *H.B.*

S. viminalis, *Linn.* *Common Osier.*
Native: In hedges and near rivers and pools. Locally common. April, May.
I. Olton Reservoir; near Forge Mills; near Kingsbury, &c.
II. Coventry Park, *T. K.*, *Herb. Brit. Mus.*; Old Park, *Y. and B.*; Radford Semele; Milverton, *H.B.*; Rowington; wood, near Lighthorne.

S. Smithiana, *Willd.* *Silky-leaved Osier.*
Native: In hedges, bushy places, and in osier holts. Rather rare. April, May.
I. Bentley Heath, near Solihull; near Henfield; Knowle; Berkswell.
II. (*S. mollissima*.) Wixford, Salford, *Purt.* iii., 74; Kenilworth, Beausale, *Y. and B;* Wyken Church, *T. Kirk*, *Herb. Brit. Mus.*; Hatton; Haseley, *H.B.;* near High Cross, Pinley; near Holywell.

S. ferruginea, *Anders.* *Ferruginous Osier.*
Native: On damp heath lands and near pools. Rare. April.

I. Meercote Pool, near Berkswell, *H.B.* Bentley Heath; canal bank near Solihull.

b. rugosa.

I. Lane near Solihull; Honiley.

II. Wyken and Pinley, *T. Kirk, Herb. Brit. Mus.* Shrewley, *Y. and B.* Kenilworth, *H.B.*, *Ex. Club. Rep*, 19, 1879.

S. acuminata, *Sm.* *Long-leaved Willow.*

Native: Near pools and rivers. Very rare. April.

I. Near the marl pits. near Knowle Railway Station.

II. Shrewley, *R. L. Baker, Herb. Brit. Mus.* River Avon, near Warwick, *H.B.*

S. cinerea, *Linn.* *Common Sallow.*

Native: In woods, hedges, bushy places, heath lands, and heathy roadsides. Common. March, April. Area general.

b. aquatica, Sm. Rather local.

I. Sutton Park; Coleshill Heath; near Stonebridge; Bentley Heath.

II. Swampy places at Oversley and Ragley Wood, *Purt.* ii., 471. Brownshill Green, *T. Kirk, Herb. Perry;* Haseley; Kenilworth; Myton, *H. B.;* between Rugby and Dunchurch, *L. Cumming.*

c. oleifolia, Sm. Local.

I. Sutton Park; Coleshill Heath; Bentley Heath; Birchy Leasowes, near Earlswood.

II. Whitley, 1856, *T. Kirk, Herb. Brit. Mus.* Near Quinton Pool, Coventry, *T. K., Herb. Perry.* Bog at the Woodlow; Warwick Old Park; Kenilworth, railway banks, *H.B.;* near Rugby! *L. Cumming;* near Tysoe; Itchington Holt; Oakley Wood; Alveston Heath.

I have found a form of *S. cinerea*, var. *a*, on Bentley Heath, in which both male and female catkins were plentifully produced on the same plant, frequently on the same branch and in some cases both stamens and pistils in the same catkin, and also a peculiar variety near Hockley, in which some of the stamens were developed into abortive pistils, or it may be that in this case there were staminiferous and pistilliferous flowers in the same catkin.

S. aurita, *Linn.* *Wrinkled-leaved Sallow.*

Native: In woods and on damp heaths and heathy roadsides. Locally common. March to May.

I. Copse near Coleshill Pool! 1836, *Mr. Ick., Herb. Perry.* Sutton Park; near New Park, Middleton; Bentley Common; Coleshill Heath; Marston Green; Bentley Heath, near Solihull; lanes near Solihull and Shirley; Honiley; near Umberslade; near Tanworth.

II. Hedges between Rugby and Dunchurch; hedges near Alcester, *Purt.* iii., 76. Kenilworth, *Kirk, Herb. Brit. Mus.* Wall Hill Wood, *T. K., Herb. Perry.* Haywood, *H. B.* Near Rugby, *L. Cumming.* Henley-in-Arden.

S. caprea, *Linn.* *Great Sallow.*

Native: In copses, woods, hedges, and on heaths and railway banks. Very common. March to May. Area general.

S. laurina, *Sm.* *Shining dark-green Willow.*

Native? Near pools and canals. Very rare. April.

II. Shrewley Pool, *H. Bromwich!* *Ex. Club Rep.*, 1875. On the banks of the canal near Brown's Over, *R. S. R.*, 1877.

S. nigricans, *Sm., Fries.* *Dark-leaved Sallow.*
Native: Near pools. Very rare. April.
c. Forsteriana, Sm.
II. (*S. nigricans*, Sm., *b. cotinifolia*), Shrewley, Warwickshire, May 16, 1876. Dr. Boswell thinks that this is probably *S. Forsteriana*. *Ex. Club Rep.*, 1876.
f. Damascena, Forbes.
II. Shrewley Pool, *H. Bromwich!* *Ex. Club Rep.*, 1876. Hatton, *H.B.*

S. repens, *Linn.* *Dwarf Willow.*
Native: On damp heathy places. Rare. April, May.
I. Coleshill Heath! *Bree*, *Purt.* iii., 72. Coleshill Pool; Ballard's Green, Arley.
b. fusca, Linn. Very rare.
I. Coleshill Pool, *T. Kirk*, probably extinct.
f. incubacea, ? Linn. Very rare.
I. Coleshill Pool; Ballard's Green, near Arley.
g. argentea, Linn. Very rare.
I. Coleshill Pool; sparingly in 1876-84.
[*S. stipularis*, Sm., is recorded from Harborough Magna, on the authority, I believe, of the *Rev. A. Bloxam.* There is, however, much doubt as to the correctness of this record.]
[*S. phylicifolia*, Linn, is also recorded without locality in the Rugby School Report for 1871.]

CONIFERÆ.

TAXUS.

T. baccata, *Linn.* *Yew.*
Alien: In old hedges, rarely in copses. March, April. This occurs at intervals throughout the county. I have, however, never seen it in what I should consider a truly naturalised state. Some of the plants in our old hedges may be spontaneous growths; but on this point I have no reliable information.
[*Pinus sylvestris*, Linn. Numerous seedlings of this are found in our old woods, and I have no doubt that this tree was at one time native. Very large trunks have been excavated from some depth below the surface soil on the wilder parts of Sutton Park. Some fine examples of this tree may be seen near Guy's Cliff, and on the Dunchurch Road, near Dunchurch.]

MONOCOTYLEDONS.

TYPHACEÆ.

TYPHA.

T. latifolia, *Linn.* *Broad-leaved Reed Mace.* *Bulrush.*
Native: In rivers, canals, and pools. Locally common. July. Area general.

T. angustifolia, *Linn.* *Narrow-leaved Reed Mace.*
Native: In pools and ponds. Rare. July.
I. Sutton Park; Pond near Bromford Forge; Blackpool, Merivale.
II. In a pit on Alne Hills, near Shelfield, *Purt.* ii., 483; in an old pit at Coton; Stivichall; Burn Post, near Kenilworth! *T. Kirk, Phyt.*, ii., 971; in a pond near the bridle road from Dunchurch to Barby, *R.S.R.*, 1877.

SPARGANIUM.

S. ramosum, *Huds.* *Branched Bur-reed.*
Native: In rivers, canals, pools, ponds, and ditches. Locally common. June, July. Area general.

S. simplex, *Huds.* *Unbranched Bur-reed.*
Native: In canals, pools, ponds, and ditches. Rather rare. June to August.
I. Sutton Park.
II. Near the Lodge Farm, Snitterfield, Washford near the Bridge. *Purt.* ii., 439; small pond near Blue Boar Lane; *L. Cummin, R.S.R.*, 1878; Honington Park! *Newb.*; Salford Priors! *Rev. J.C.;* Kineton, *Bolton King;* canal near Bearley; Sowe Waste Canal.

S. minimum, *Fries.* *Small floating Bur-reed.*
Native: In pools. Very rare. July.
I. (*S. natans*) Packington, *Aylesford B.G.*, 636; in a pit on Ansley Coalfields, *Blox. Phyt.* iii., 324.
II. In a pool near Roundshill Lane, Kenilworth, *T. Kirk;* road from Coton House to Cave's Inn, *Cheshire*; Arbury, *T. Kirk, Herb. Perry.*

ARACEÆ.

ACORUS.

A. Calamus, *Linn.* *Sweet Flag. Sweet Cane.*
Native (?) In rivers and large pools. Rare. May, June.
I. River Tame at Tamworth, at the bottom of Mr. Oldenshaw's garden; *With* (Ed. 3) i., 358; between Knowle and Temple Balsall! *H.B.* Abundant in June, 1883.
II. Abundant in most of the waters near Arbury Hall! in two ponds at Foleshill, but originally planted from a pond near the Stoke Race Course, which is now filled up, *T. Kirk, Phyt.* ii., 971; Milverton; Guy's Cliff! *H.B.;* Farnborough.
Introduced at Arbury, and probably also in all the other stations above quoted.

ARUM.

A. maculatum, *Linn.* *Cuckoo-pint, Wake Robin, Lords and Ladies, &c.*
Native: On hedge banks and in woods. Locally common. April, May. Area general.
Abundant in some of the districts, but remarkably local in others, occurring, however, throughout the whole county.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.
BY HERBERT SPENCER.

EXPOSITION OF CHAPTER VII., PART I.,
AND
CHAPTER I., PART II.

BY W. GREATHEED.

Chapter 7, Part I.—"*The Scope of Biology.*"

Having ascertained in prior chapters that organic matter is that matter which is specially sensitive to surrounding agencies, that its very unstable compounds in becoming stable give out motion, and that the changes of which life is made up are internal adjustments to balance outer changes, we come to the question how the science of life, usually called Biology, shall be mapped out. Mr. Spencer indicates such a map, chiefly useful for future application, because much of the territory is inadequately explored. We may study (1) structure, or (2) function, or (3) the interactions of structure and function; and each of these three subjects may be studied with special reference to (*a*) the race or (*b*) the individual. We have also to study (4) genesis, or the production of successive individuals.

The study of structure includes morphology (form study) and embryology (egg study), whilst the study of function includes physiology and psychology. The study of the interactions of structure and function is illustrated by such works as Mr. Darwin's "Origin of Species." And under Genesis we may study Sexual and Asexual multiplication.

Chapter 1, Part II.—"*Growth.*"

Growth is the assimilation of similar atoms, and may be either organic or inorganic. The wick of an unsnuffed candle, or a geological deposit, illustrate the latter kind. Limits to growth are almost peculiar to the organic kingdom; not quite, however, since the growth of crystals has limits. The conditions of growth are numerous. The more complex the structure or the greater amount of fit food procurable, or the more economy in expenditure of force, the greater the probable size of the animal. Again, the initial bulk of the egg or of the embryo, and the easy supply of food, as in the case of the nourishment supplied at the breast by Mammalia, affect the question. Not only must there be a sufficient supply of assimilable matter, but each variety of food must be present, since, *e.g.*, an absence of lime would dwarf the skeleton; while the fact that the machinery of absorption is limited in surface and power, would of itself check the growth of an Oliver Twist, even though Mr. Squeer's treacle and philanthropy were as inexhaustible as the cruse of oil, or, better still, as the National Debt.

But the increments called growth at last absolutely cease. The same food which is used up as force cannot be used to increase bulk, and since it is a mechanical axiom that the strain incurred in the movement of a large bulk is proportionately greater than the strain incidental to that for a small bulk, it follows that a time must come when the whole of the food will be used up in the production of force. If the Claimant, who is shortly to make his exit from prison, weighs twenty-five stone—while a child weighs five—the force which the ex-convict must exert to walk away from the doors is not five times the exertion of the child in covering the same distance, but a great deal more than five times. The bulk of the food which he has eaten will be required for locomotive purposes, a proportion will go to replace waste, and none will be left for addition. Long ago, if plethora be not an exception to Mr. Spencer's rule, the Claimant reached the "state of moving equilibrium." Then there are minor considerations. No little energy is used up in the transport of material from the absorbing surface to the periphery of Mr. Orton's person, though, on the other hand, it has to be conceded that Mr. Orton's person, being of considerable bulk, would lose and consequently have to brew heat (a fancy energy) less rapidly than when he was young and innocent.

Applying the general principle to less noteworthy instances, we shall expect to find some complications. Plants have scarcely any limit of growth, and this may be due to the fact that they have not to expend force. The pike and the crocodile, which are alleged to grow as long as they live, may do so because their mode of life requires little display of energy, and the former lives in a medium of the same density as its body—in a condition, in fact, of perpetual sofa.

Variations must, of course, be expected in the application of this theory, different species having such very different modes of feeding, digesting, and behaving. The rule will apply best of all to individuals of the same species.

As has been said, the ultimate size largely depends on the initial bulk with which a creature starts. Of two men, one a manufacturer and the other a street vendor, given equal quantities of shrewdness; the manufacturer makes the larger profits, the street vendor being handicapped by absence of capital. A tree gets ahead of the herbage because, from the first, it is richly endowed with food.

To Mr. Spencer's summary of this chapter, as being far clearer than my exposition, the reader is referred.

PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Reply to Mr. Lawson Tait's Note.

BY W. B. GROVE, B.A.*

Mr. Lawson Tait's note in last month's "Midland Naturalist" raises so many questions that a brief reply must necessarily leave some of them untouched. Still, I think it can be shown that, in one or two respects at least, he falls short in some degree of the truth. We are glad that a discussion has been raised, because it is chiefly by such means that the accused finds out the weak points in his armour, and the accuser has the chance of being converted.

In the first place, it is surely necessary that he who attempts to criticise Herbert Spencer should have read Herbert Spencer carefully and well. But Mr. Tait's reference to the "contradiction" on p. 205, and his putting forward the example of *Anacharis Alsinastrum* again in the next paragraph, render it difficult to avoid the conclusion that he considers the opinions contained on that page as Herbert Spencer's own. Now, all attentive readers of the Principles of Biology know that this view of the nature of an individual is being quoted from Dr. Carpenter and Professor Huxley, and is just that which Herbert Spencer denies. This is not a promising beginning for the critic.

In the second place, it is essential, in comparing the life-activities of different species, that any particular comparison should be restricted to those which stand in the same line of descent. For while the general argument that "the length of life varies as the degree of correspondence" is seen to be true, on the whole, by a general survey of the organic world,† yet

* Mr. Barratt having intimated his intention of not making any reply at present, the Secretary of the Section has asked me to do so.

† This theorem is proved by (Professor) Ray Lankester, in his "Comparative Longevity," published in 1870. This is avowedly based upon the "Principles of Biology," which the author finds to give the key to the facts, so far as they are known.

when we descend to particular instances we should expect occasionally to find discordances, and to find those discordances more evident when the comparison lies between distinct lines of evolution than when it is made between organisms which belong to the same line. In its own line the elephant is the most sagacious, and the life which it enjoys is higher than that which falls to the lot of any other pachyderm.

In the third place, it seems indisputable that for reckoning the degree of life enjoyed by any organism, the mere number of years which it passes through is a most fallacious guide. We must take account not only of the *length* of life but also of its *intensity;* and in cases where the vital activity manifests itself in the work of the brain as well as in that of the limbs, this resolves itself into the statement that the true measure of life is the sum of the mental and bodily activities which come into play during its continuance. Tried by this test, it is plain that not only the life of a Darwin or a Spencer, but also the average life of the human race, is superior to that of an unspeculative, uncritical elephant.

In the fourth place, Mr. Tait actually admits the truth of the theorem which he imagines he is disputing, for he says that man "enjoys a very much higher form of life than" the elephant, and he implies (what can scarcely be denied) that the amount of correspondence with external forces possessed by the human organism is greater than that exhibited in the elephant, and what is that but to allow that in comparing these two cases "the degree of life varies as the degree of correspondence"? The fact is, Mr. Tait has not made himself duly acquainted with the theory which he undertakes to discuss. Throughout Chapter vi. the term *longevity* is nowhere used, while passages are abundant * which show that the view of "degree of life" here taken is that which the great philosopher intends.

In the last place, even if it be granted that a few apparent exceptions to his generalisation exist, that is a scarcely sufficient ground on which to erect such a sweeping denunciation of Herbert Spencer and all his works. To do this is to forget the intricacy and many-sidedness, the interaction and counteraction of forces, by which all biological problems are pre-eminently distinguished.

* See p. 84, l. 12; p. 85, l. 8; p. 89, l. 16; p. 90, l. 5. Mr. W. R. Hughes has called my attention to the following passage in "Felix Holt," vol. iii., chap. 49:—"Life is measured by the rapidity of change, the succession of influences that modify the being."

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

PETERBOROUGH MEETING, JUNE 25TH AND 26TH, 1884.

The Seventh Annual Meeting of the Union was held at Peterborough during the last week of June. Favoured by glorious weather and a good attendance of members and their friends, the gathering proved a great success.

The Council Meeting was held in the Town Hall on Wednesday, June 25th, at 12-45 p.m., and was attended by seventeen delegates. Reports from the Hon. Secretaries and the Management Committee were read, and the draft of the General Report was read and discussed. Mr. A. W. Wills ably brought forward the subject of the extermination of rare plants, and it was resolved that the Management Committee (on which twenty-four members were elected to serve) should at once consider the question.

The Annual General Meeting was held in the Fitzwilliam Hall, at 3 p.m., on the same day. Previous to the meeting, the members partook of lunch in an adjoining room. About one hundred members and friends attended the meeting, among whom were Sir Herewald Wake and Mr. B. Thompson, F.G.S., Northampton; Messrs. W. P. Marshall, M.I.C.E., C. J. Watson, H. Miller, W. B. Grove, B.A., Thos. Bolton, and J. Rabone, Birmingham; E. de Hamel, Tamworth; H. Pearce, F.L.S., Stourbridge; W. Madeley, George Perry, and — Williams, Dudley; Revs. O. M. Feilden and G. G. Monck, Oswestry; Messrs. T. W. Cave, M.R.C.V.S., and J. T. Jepson, Nottingham; Dr. F. W. Crick, Bedford; Messrs. F. T. Mott, F.R.G.S., Leicester; G. C. Druce, Oxford, &c., a large number of the members of the Peterborough Natural History and Scientific Society, and the Hon. Secretaries to the Union (Messrs. J. W. Bodger, Peterborough; and W. J. Harrison, F.G.S., Birmingham).

The President of the Union—the Very Rev. Dean Perowne—being unavoidably absent, the chair was occupied by Dr. T. J. WALKER, who read the President's Address, which dealt in a most interesting and thorough manner with the Cathedral of Peterborough, and the discoveries which have been made during the extensive alterations in that grand edifice which are now in progress.

The thanks of the meeting having been tendered to the President for his very able address (which will be printed in the September Number of the "Midland Naturalist"), Mr. W. J. HARRISON read the Annual Report [see July No., p. 201], which was received and adopted.

PRESENTATION OF THE DARWIN MEDAL.

Dr. WALKER then presented the Darwin Medal to Mr. W. B. Grove, B.A., announcing that it was awarded for the original researches of Mr. Grove among the Fungi.

In acknowledging the receipt of the medal, Mr. GROVE said that Charles Darwin had done much to raise the so-called "inexact" natural history sciences to the rank of "exact" sciences. He considered the Fungi to merit close and long-continued study, for they were intimately connected with many matters closely affecting the well-being of mankind.

HONORARY TREASURER'S REPORT.

Mr. E. DE HAMEL read the financial statement for the year.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

BALANCE SHEET.

Date	Receipts.	£ s. d.	d.	£ s. d.
1883. June 12.	Balance of Treasurer's Account	2 7 2		
„ 18.	Subscriptions Burton Society for 1883, 174 at 3d.	2 3 6		
July 26.	Subscriptions and Arrears Bedford Society ...	2 5 7		
„	Nottingham Literary and Philosophical Society for "Midland Naturalist"	2 0 0		
				8 16 3
1884. May 21.	Oxfordshire Natural History Society	20 at	3	0 5 0
„	Oswestry and Welshpool Naturalists' Field Club... ...	40	3	0 10 0
„ 22.	Birmingham Philosophical Society	129	3	1 12 3
„	Severn Valley Naturalists' Field Club	68	3	0 17 0
„ 23.	Nottingham Naturalists' Society	94	3	1 3 6
„	Bedfordshire Natural History Society and Field Club ...	60	3	0 15 0
„ 26.	Dudley and Midland Geological and Scientific Society and Field Club	100	3	1 5 0
„ 29.	Birmingham School Natural History Society	50	1	0 4 2
„	Peterborough Natural History and Scientific Society ...	112	3	1 8 0
June 10.	Evesham Field Naturalists' Club	35	3	0 8 9
„ 11.	Birmingham and Midland Institute Scientific Society...	246	1	1 0 6
„ 13.	Leicester Literary and Philosophical Society	268	3	3 7 0
„ 17.	Nottingham Working Men's Naturalists' Society... ...	30	1	0 2 6
„ 18.	Birmingham Microscopists' and Naturalists' Union ...	40	3	0 10 0
„ 20.	Birmingham Natural History and Microscopical Society	259	3	3 4 9
„	Northamptonshire Natural History Society and Field Club	200	3	2 10 0
„ 21.	Caradoc Field Club	62	3	0 15 6
„	Tamworth Natural History, Geological, and Antiquarian Society	96	3	1 4 0
	Balance			5 6 0
				£35 5 2

Date	Payments.	£ s. d.	£ s. d.
1883. July 31.	"Midland Naturalist" from Nottingham Literary and Philosophical Society	2 0 0	
„	Balance of Darwin Die Fund	0 17 6	
			2 17 6
1884. June 25.	Treasurer's Expenses, stamps, &c....		0 4 0
„	Secretary's ditto		1 9 6
„	Wright, Dain, Peyton, and Co., Printer's bill, 1883-4		21 19 2
„	Joseph Moore, Darwin Medal (bronze)		0 4 6
„	Mr. Grove, Darwin Medallist, bronze medal, and		8 10 6
			£35 5 2

There is a considerable falling off in numbers amongst the Societies in the Union, the total number of Societies having decreased from 23 in 1883 to 19 in 1884, and the gross number of members from 2,416 to 1,965 during the same period; this is mainly owing to the cessation of the Cheltenham, Banburyshire, Burton, and Nottingham G.R.S., and to the general decrease in reported number of subscribing members by the various Societies.

The result of this is that we find the receipts, including the balance carried forward last year and the then outstanding arrears since paid up, amount to £29 19s. 2d. Against this we have to take into account the £2 donation of the Nottingham Literary and Philosophical Society to the "Midland Naturalist," and the 17/6 contra balance of the Darwin Die Fund, together with Treasurer's expenses 4/-, Secretaries' ditto 29/6, Printers' Bill £21 19s. 2d., and Bronze Medal 4/6, total £26 14s. 8d., leaving a balance of £3 4s. 6d. at the disposal of the Council.

It is customary when the Darwin Medallist so elects to present him with the difference in money value between the cost of the gold medal,

£8 15s., and of the bronze medal, 4/6, *i.e.*, with £8 10s. 6d.; if this be done the credit balance of £3 4s. 6d. will be converted into a debit balance of £5 6s., and it will be necessary for the Council to consider what steps should be taken to meet this in the coming year.

Votes of thanks were then passed to the Officers of the Union (acknowledged by Mr. W. J. Harrison), and to the Officers and Members of the Peterborough Natural History Society (acknowledged by Dr. T. J. Walker).

It was resolved that Mr. T. H. Waller, B.A., B.Sc. (Birmingham) should be elected as Honorary Secretary for the ensuing year, and that Mr. E. de Hamel should be re-elected as Honorary Treasurer.

The meeting terminated with a vote of thanks to the Chairman, proposed by Sir H. Wake, and seconded by Mr. de Hamel.

LOCAL EXCURSIONS.

Immediately after the meeting a large number of the members of the Union proceeded to the Cathedral, where they were met by the Rev. Canon Argles and the Rev. Canon Macdonnell. The former gentleman entered into a long description of the building, giving an account of its early history, and explaining its construction, and the style of architecture. After inspecting the nave the restoration works were visited, and here Canon Argles thoroughly explained the old defects and the reasons for pulling down the central tower. A few of the members went on a botanical excursion to Thorpe Hall (by kind permission of C. I. Strong, Esq.) and Holywell, returning by the River Nene; others paid a visit to the section of cornbrash exposed by the railway.

CONVERSAZIONE.

A very successful Conversazione was held in the Fitzwilliam Hall on Wednesday evening. The tables were arrayed with various objects of local and general interest, scientific, antiquarian, literary, &c., including relics from the Fenland and Saxon and Roman remains from Castor, Peterborough, and neighbourhood; the collections of flint implements, fossils, and Roman and Saxon pottery, bronzes, weapons, &c., being remarkably good. The objects under the microscopes were of the usual character, and there was a capital fresh-water aquarium. At intervals selections of music were performed by a band, under the directorship of the Rev. W. F. Wilkinson.

In the course of the evening Dr. T. J. Walker delivered a very interesting address on the Pre-historic and Roman Remains found in the neighbourhood of Peterborough, illustrating his remarks by the actual specimens, of which there was a grand display in the numerous glass cases.

Afterwards, in the adjoining hall, Mr. W. Jerome Harrison, F.G.S., lectured upon "The Ice Age and the Stone Age," illustrating his remarks by a number of views, admirably shown by the oxyhydrogen lime-light.

SECOND DAY—THURSDAY, June 26th.

UPLAND EXCURSION TO BEDFORD PURLIEUS.

Leader, Mr. J. W. Bodger.

Starting from Peterborough Market Place at nine o'clock, the "Alpine" party (about thirty-five in number) drove westward to Water Newton, where the river gravels were examined, and where some of the visitors obtained quite a collection of (fragmentary) Roman pottery. After examining Chesterton Church, the drive was continued to Stibbington Hall, where Captain and Mrs. Vipan most kindly and hospitably received the party, and here a very pleasant hour was spent in the inspection of the Indian and Burmese objects of Art, and in strolling through the lovely grounds, the orchid houses, and the aquaria. After thanking the hosts for their kindness, the drive was continued to the most westerly point reached—Bedford Purlieus—a wild, windy region where many rare plants still grow, and where the fly orchis and blue columbine grow freely. After lunch a return was made through Wansford to Sutton Marsh, where the botanists discovered a large quantity of — mud. Peterborough was reached about half-past five, and here the Fenland party were joined at tea in the rooms of Mr. J. House, by whom the whole of the catering for the meeting was carried out in a thoroughly satisfactory manner.

Fenland Excursion—Crowland Abbey.

Leader, Mr. E. J. Lilley.

The Fenland party took a north-easterly route, and the first point visited was the Decoy, where wild birds are captured during the winter in Borough Fen. The mode of working the Decoy was clearly explained by Mr. T. B. Williams and his sons. Thence the party proceeded by the bank to Crowland, and went direct to the Abbey, where the Rev. T. H. Le Bœuf addressed the company in the belfry on the history and architecture of the Abbey. He afterwards accompanied the party round the venerable pile, and explained the chief features of interest, commencing with the original Norman door-way, which has but of late been opened up to view inside the porch ; from thence he proceeded to describe the figures on the west front and round the nave and south aisle, after which the fine old Norman or Saxon arches of the great central tower were noticed, and the company completed their visit by inspecting the fine old plate belonging to the communion service of the church, and the parish registers, which go back to early in the 16th century. One of the first entries refers to the death of Oliver Cromwell. From the dissolution of the monasteries for a period of 120 years the registers are missing. About 75 years ago the Rev. James Blundell obtained nearly 100 years of the old registers from some person in Cambridgeshire. Should any antiquarian know where the series could now be completed he would confer a great favour on all students of our old records by publishing the information. After lunch at the George Hotel, a vote of thanks was given to the rev. gentleman for the very able address he had given on the Abbey. The Society then adjourned to the remarkable triangular bridge, the history and peculiarities of its architecture and situation being pointed out by Mr. A. S. Canham. The party next inspected, at Mr. Canham's residence, a rare collection of old engravings of the most interesting objects in the neighbourhood, and a very complete collection of the flint implements used by pre-historic man, gathered from a tumulus which was taken down three years ago, when the wash bank was heightened. The party, after heartily thanking Mr. Canham for the pleasure and interest he had afforded, took their carriages, which were awaiting them, and proceeded on their way to Thorney, noting as they went the contact of the three counties, Lincoln, Cambridge, and Northampton at Noman's Land, and Turketell's Cross, standing near to Pepper Lake, in which it lay for many years prior to about 1825, when it was taken out and re-erected. After examining Thorney Abbey a rapid return was made to Peterborough, which was reached in good time for tea and the 6.30 train, by which most of the visitors departed, bearing with them very pleasant remembrances of this well-planned, well-managed, and very successful meeting, for whose success the local members must have worked both hard and well.

[We are indebted to Mr. G. Claridge Druce, F.L.S., for the following Botanical Notes.—Eds. *M.N.*]

The Fenland expedition of the members of the Midland Union furnished little of special interest to reward the botanist. The district traversed, once and at no very distant period the haunt of such plants as *Cladium Mariscus*, *Cicuta*, *Stratiotes*, *Pilularia*, *Teucrium Scordium*, and *Villarsia*, was now covered with rich wheat fields, pleasing to agriculturists, but most barren to botanists; and the dyke-sides, which stretched out in unpicturesque straightness, were bordered only by such plants as *Glyceria aquatica* and *Carex riparia*, and were often too stagnant to show anything upon their surface besides Lemna. Here and there *Hottonia* was welcomed by the Warwickshire botanists, and in a dyke near the Welland occurred a new addition to the Northampton Flora, *Callitriche obtusangula*, a very distinct-looking plant. The far-famed Decoy Farm, in Borough Fen, was also extremely poor in vegetation, nothing unusual occurring in its osier beds and waters. Nor did Crowland or Thorney yield anything to the botanist.

The Upland party went over much richer ground, and I determined on Friday to make an expedition in that direction; so, taking the train to Wakerley station, I commenced work by searching Wakerley Wood. Here occurred *Asperula odorata*, rare in Northants, *Atropa Belladonna*, confined to the north-east of the county, *Melampyrum pratense* (*M. cristatum* was not in flower), *Ophrys apifera*, *Dipsacus pilosus*, *Echium*, *Verbascum Thapsus*, and *Euphorbia Lathyris*. This latter plant is probably a native here, as it occurs in some of the old woods, as at Fineshade and Wakerley, and Mr. Mott found it by the side of Bedford Purlieus. I made careful search but could find no trace of introduced plants, and one can quite agree with Babington's remark on this italicised plant of the London catalogue—" that it is a native of some stony and rocky woods."

The road between Wakerley and Duddington was bordered with *Crepis biennis*, and a form of Ballota occurred, which, in had long calyx teeth, and may be *ruderalis*.

On Colleyweston quarries I gathered *Aceras anthropophora* and *Orchis pyramidalis*, with *Arabis hirsuta*, *Koeleria*, *Avena pubescens*, *Bromus erectus*, and *Brachypodium pinnatum*. The stream, which begins at the White Water, near Stamford, and ends at Sutton Marsh, affords almost the only remaining portion of bog vegetation in Northamptonshire, and very rich it is; a profuse growth of *Juncus obtusiflorus* being especially noticeable. *Schœnus nigricans*, *Eriophorum latifolium* and *E. angustifolium*, *Carex pulicaris*, *C. dioica*, *C. flava*, *C. Hornschuchiana*, *C. stellulata*, *C. intermedia*, *C. ovalis*, *Scirpus setaceus*, *S. pauciflorus*, *S. palustris*, *Anagallis tenella*, *Samolus Valerandi* also occurred.

In a marshy spot I found *Salix pentandra* (probably planted); *Epipactis palustris*, *Gymnadenia conopsea*, *Orchis maculata*, *O. latifolia*, and *O. incarnata* were frequent, the flesh-coloured variety of the latter in full flower on June 27th; a hybrid between *incarnata* and *maculata* was also found. *Carduus pratensis* was rare, and one or two specimens of *C. palustri-pratensis*, near to, if not identical with *C. Försteri*, were gathered.

Menyanthes was in beautiful flower; a short-leaved, much-encrusted form of *Chara fœtida* was present in the wetter portions, while the grasses were represented by *Molinia*, *Triodia*, and *Aira cæspitosa*. Here and there, too, were the tussocks of *Carex paniculata*; *Pedicularis palustris* and *Pinguicula* were also seen. It was curious to notice how close to and sometimes even mixed with the marsh plants occurred *Brachypodium pinnatum*, *Polygala depressa*, and *Bromus erectus*, but this was only where the stony soil was close to the surface.

Having traversed some miles of this interesting strip of marsh, I visited the quarries of Southorpe; here occurred *Asperula cynanchica*, *Verbascum nigrum*, *Anthyllis*, *Onobrychis*, *Marrubium vulgare*, etc., but the drought had spoiled the place for botanising. *Chlora perfoliata* was gathered near Ufford.

The river side near Peterborough was not particularly rich; *Sium latifolium*, *Zannichellia palustris*, *Œnanthe fluviatilis*, *Potamogeton perfoliatus*, *P. lucens*, *P. pectinatus*, and *P. crispus; Ranunculus fluitans* and *R. pseudo-fluitans* were plentiful in the Nene.

In the dyke east of Peterborough, *Hydrocharis*, *Polygonum maculatum*, *Ranunculus sceleratus* (most abundant), *Œnanthe Phellandrium*, *Polygonum mite*, *Rumex maritimus*, *Callitriche platycarpa*, and *Iris acoriformis* were the representative plants.

It will be seen from the above list that a fair quantity of specimens may be found even in a short visit to an unpromising-looking neighbourhood, and there is little doubt that systematic search of the district would add several plants to the Northampton Flora.

I must conclude these rough notes by expressing my thanks to the Peterborough Society for their well-planned excursions and meetings, which afforded their visitors much pleasure.

[The following is communicated by the REV. M. J. BERKELEY.]

If we look back forty or fifty years, it would be impossible to fix on a more hopeful point than Peterborough for interesting research. Three members of the household of the late Earl Fitzwilliam worked out the whole country in almost every point of interest. Mr. Artis, the house steward, made an especial study of the site of Durobrivæ, and though the text of his work was never published, the illustrations command the attention of archæologists to this day. Mr. Simmons, the head cook, made, with considerable intelligence, a large and varied collection of the insects; while Mr. J. Henderson, the head gardener at Milton, a man of extensive information and original research, worked out not only the botany but zoology, and his paper on the "Germination of Ferns," in one of the earliest volumes of the "Annals of Natural History," still bears witness to his power as an observer and draftsman. This was, of course, before so much of the Fens had been drained, and though perhaps it would be difficult now to obtain specimens of such plants as *Liparis Loeselii*, *Malaxis paludosa*, *Viola lactea*, and the rare fern *Aspidium cristatum*, or *Andromeda polifolia*, diligent research might afford us in Holm Fens *Teucrium Scordium*, and other varieties. But the Soke country, with its woods and varied geology, will still yield us a good harvest of Lepidoptera and other insects, while the woods give us *Inula Helenium*, *Melampyrum cristatum*, with *Listera Nidus-avis*. And if we extend our view as far as Wansford and the neighbouring Bedford Purlieus we might still get, on the outskirts of Thornhaugh, *Chlora perfoliata*; and, if the planting of conifers in the old stone pits at Southorpe has not altered altogether the locality, there would certainly be *Anemone Pulsatilla*, *Hypochæris maculata*, *Sedum Telephium*, and possibly, for it was once abundant, *Ophrys aranifera*. Beyond Wansford there is a tract of thin soil, which yields every year a rare assemblage of species of *Phascum*, with other mosses, when the corn crop has been secured, while also growing a multitude of annual corn plants, such as *Caucalis daucoides*, *Silene noctiflora*, *Antirrhinum*

Orontium, Euphorbia platyphylla; and on the roadside, with many a limestone plants, numerous specimens of the Fly Orchis; while the wood itself affords acres of Lily of the Valley, and on the further side of the Purlieus the underwood consists of indigenous specimens of *Tilia parvifolia*, and when the underwood is cut down, the whole land is sometimes blue with the common Columbine, which I think is indigenous there, if anywhere in England. The same country is undoubtedly rich in Fungi, and some part of the district has been thoroughly examined. There is no doubt that if the country were properly searched many species of Truffle would be found. The common English Truffle, *Tuber æstivum*, certainly occurs at Milton. At Apethorpe it is sometimes so abundant that one or more pounds may be collected by experts in a few minutes, and in the lime region of Bedford Purlieus nearly twenty species have been found. Nearer home we may observe that in the brickfield at Whittlesea the late Dr. Porter made many valuable discoveries, and there is still the same opportunity and hope of novelty, and such rare plants as *Lythrum hyssopifolium* may still reward close research in swampy ground. Much might be added of interest, but to enumerate all the capabilities of the neighbourhood would require a formal paper and more energy than an old naturalist in his 82nd year can command.

METEOROLOGICAL NOTES.—June, 1884.

The barometer, which was falling at the commencement of the month after a slight fluctuation, rose steadily till the 12th, from whence it continued generally high without material alteration. After the 8th the weather was fair, with light air, chiefly from the westward, though cloud was prevalent, and the amount of sunshine below the average. Some high temperatures were recorded, the maximum exceeding 82° at Loughborough and Henley-in-Arden on the 28th; on the 13th 80°·9 was registered at Strelley, and 80°·7 at Hodsock. The minima were low for the time of the year; the lowest readings were registered on the 1st: 30°·2 at Coston Rectory, 32°·3 at Hodsock, and 33°·0 at other stations. On the grass 5 degrees of frost were registered at Hodsock and Strelley, and 4 degrees at Loughborough. The rainfall was decidedly below the average, the total values being less than 1 inch at Hodsock, Strelley, and Coston Rectory; and 1·13 inches at Loughborough. At Henley-in-Arden the total was 2·95 inches. The number of rainy days varied from 6 to 10, and as the greater portion of the rain fell at the beginning of the month the grass crops suffered severely. Lightning and thunder were observed on the 5th and 6th.

Wm. Berridge, F.R.Met.Soc.

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Natural History Notes.

Notes from Woking.—Curled Web of Spider.—During May and June, amongst the heather I observed a great number of the small webs of *Dictyna latens*—*Ergatis latens*, of Blackwall, one of the spiders belonging to the family Dictynides, all of which possess four pairs of spinners instead of three pairs, which is the usual number possessed by other spiders. The metatarsus of the posterior leg is provided with a peculiar apparatus, the calamistrum, which is used in connection with the extra pair of spinners in forming the curious and beautiful curled web. This spider generally selects the old flower head of the common heath, *C. vulgaris*, in which, or upon which, she proceeds to spin her web, first running a number of plain threads from the top and central twig to those which spring about half an inch below, until she has formed a tent-like structure. When this is finished she spins a few plain threads from these side twigs to the central stem below, generally about three-quarters to one inch long, sometimes longer, and if another twig is near she runs out a line to it. The web is now somewhat of an elongated diamond shape, much like the purse nets used by fishermen, but so far it is only a covering and habitation for the owner. The most important and wonderful part of the structure next occupies her attention—viz., the spinning of the curled webs, without which no flies could be snared. After a great many watchings, at last I was rewarded by seeing one commence the curling operation. Taking up her position, head downwards, on one of the threads running from a side twig to the central stem, she slightly raised her abdomen, bending the posterior pair of legs until the claws apparently touched the spinners. She then moved them rapidly to and from the abdomen some twelve or fifteen times, then resting a moment, she attached something to one of the plain threads, moved on and down the diagonal thread a very short distance, then repeated the rapid movements, rested again, moved a little to one side, fixing something to the thread running parallel to the one she was on. I very carefully brought my magnifier to bear, and then saw that whilst making the rapid movements she had been (no doubt using the calamistra) tearing, so to speak, her silk from her spinnerets, and by the short movements of the legs made the wonderful curled and double thread which, after each rest, she attached first to one side then to the other of the parallel plain threads, thus covering the threads from the side twigs to the central stem, and a few to the top with a zigzag of this pale blue curled web, and this again was surrounded by the most extraordinary thread of some sort, which looked exactly like a delicate vapour around it, and in which the unlucky flies were soon caught, neatly spun up in a silken shroud, carried up into the diamond chamber, and after having satisfied the hunger of the neatest "curler" ever known, their wings and legs are hung up outside as ornaments, and very beautiful they look when the sun is upon them. The male is found after dark rapping with his palpi in the most comical manner against the outside of the chamber, and if his wooing is acceptable he is admitted, but if not, the sooner he drops his strumming himself the better, for the lady is not against feeding upon her species when necessity compels. She lays her eggs in several small cocoons within the nest and carefully watches them until hatched.—F. Enock, Ferndale, Woking.

Two New British Uredines.—*Œcidium Convallariæ*, Schum. Spots pale yellow or whitish, circular, on various green parts of the host plant, leaves, stems, and perigones. Pseudoperidia cup-shaped, with broad, overhanging, split, whitish edges. Spores polygonal, orange yellow, slightly rough, 15-30 × 14-22 mk. On *Convallaria majalis*, near Scarborough; Mr. G. Massee, June, 1883. Windermere, Mr. Thomas Hebden, June, 1884. This interesting addition to our flora was sent to me last year by Mr. Massee. It is figured by Mr. W. G. Smith in the *Gardener's Chronicle* for 5th July, 1884, p. 12-13, from Mr. Hebden's specimens. On the Continent of Europe it occurs not only on lily of the valley, but on various allied plants such as *C. verticillata*, *C. Polygonatum* and *C. multiflora*, *Majanthemum bifolium* and *Paris quadrifolia*. It is synonymous with *Æcidium Majanthæ*, Schum., *Cæoma elegans*, Schum., and *C. Polygonatum*, Link.

Puccinia Anthoxanthi, Fuckel. Uredospores: Sori elliptical or linear, orange, soon naked; spores elliptical or obverse, egg-shaped or oblong, rough, dark yellow, 20-30 × 14-19 mk. Teleuto-spores: Sori scattered, small, elliptical or linear, soon naked, brown. Spores on very long stout brownish stalks, generally elliptical, more rarely oblong wedge-shaped, slightly constricted at the centre, thickened distinctly at the apex, where they are rounded, generally rounded off at the base but sometimes wedge-shaped, smooth, chestnut brown, 26-42 × 16-21 mk. On *Anthoxanthun odoratum*: King's Lynn, May and June; Bradford, Mr. H. T. Soppit, July. I have little doubt that ours is the true plant of Fuckel. There is one point, however, in which they differ, namely, in that the uredospores are accompanied by abundant and well-marked capitate paraphyses, of which Fuckel makes no mention. To those mycologists who confine themselves to anatomical characters, this would of course afford unimpeachable evidence of their distinctness. From a series of experimental cultures with the paraphysed Uredines made during the present summer, I have been led to attach less value to the presence or absence of paraphyses with the uredospores as a specific character than I formerly did. At the present time however, I cannot speak confidently but hope in the course of time to be able to throw some additional light upon the point in question.—Charles B. Plowright, 7, King Street, King's Lynn, July 15th, 1884.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, May 27th.—Mr. Thos. H. Waller described the characteristics of the minerals Augite, Hornblende, and Mica, with special reference to their appearance as the constituents of rocks, and their discrimination by the use of the microscope. In illustration of his remarks he exhibited some specimens of the various minerals and sections of rocks containing them, and Mr. C. J. Woodward also exhibited a beautiful specimen of Hornblende. Mr. J. Udall was unanimously elected Hon. Secretary of the Geological Section. Geological Section, June 24th.—Mr. W. R. Hughes exhibited a specimen of *Kieselguhr* (German earth), used in preparation of dynamite. The earth when mixed with four parts of nitro-glycerine forms dynamite. Mr. Hughes also exhibited a slide mounted by Mr. Sharpus showing fossil Diatoms, Infusoria, &c., contained in Kieselguhr. Mr. W. H. Wilkinson exhibited *Lonicera Xylosteum*, *Cornus sanguinea*, *Myrica gale*, from near Chillington, *Listera ovata*, *Ophioglossum vulgatum*, *Barbarea vulgaris*, *Carex Pseudocyperus*, *Vicia hirsuta*, and other plants from near Barnt Green. Mr. W. P. Marshall read a paper on "The Flow of Solids," which will appear in a future number of the "Midland Naturalist." General Meeting, July 1st.—Mr. W. B. Grove B.A., exhibited *Rhinotrichum repens*, new to the district, *Ustulina vulgaris*, and *Cryptosphæria millepunctata*, from this district, *Diatrype bullata* from Peterborough, and *Puccinia Smyrnii* from Ardmore, Ireland. Mr. Grove also gave a short account of the Meeting of Natural History Societies at Peterborough. MICROSCOPICAL GENERAL MEETING, July 15th.—Mr. W. R. Hughes F.L.S., exhibited *Merulius lacrymans*, a fungus which has caused "dry rot" and occasioned such damage to the woodwork of the block floor in Handsworth Parish Church, that the whole floor will have to be removed. Mr. W. B. Grove has kindly consented to examine the church, and it is hoped that he will report on it at the next meeting. Mr. W. H. Wilkinson exhibited *Melica uniflora*, from Dudley Park, and *Circæa lutetiana* (the Enchanter's Nightshade), from the Wren's Nest, Dudley. GEOLOGICAL SECTION, July 22nd.—Mr. Bolton exhibited *Pedalion mira*—living and mounted—from within four miles of Birmingham. Mr. Morley, on behalf of Mrs. Rabone, exhibited *Epipactis atrorubens*, oval-leaved, from Grange-over-Sands, and *Lastrea rigida* from same place. BIOLOGICAL SECTION, July 8th.—Mr. T. Bolton exhibited *Bythotrephes Cederströmii*, the entomostracan from Windermere, which Mr. C. Beck found for the first time in 1881. It was accompanied by *Leptodora hyalina*, *Hyalodaphnia Kahlbergensis*, and *Anuræa longispina*; Mr. W. H. Wilkinson exhibited Lichens from Scotland; *Cladonia uncialis*, *Sphærophoron coralloides*, *Platysma triste*, *Nephromium lusitanicum*. all in fruit, very rare, from Ross-shire; *Lecidea Hookeri*, *Solorina crocea*, *S. saccata*, *Peltigera venosa*, from Ben Lawers; *Parmelia aquila*, *P. stygia*, *Lecanora frustulosa*, mostly in fruit, and very rare; Mr. W. J. Harrison exhibited a roughly chipped Flint Celt, found at Six-hills, near Loughborough.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 16th.—Mr. Darley exhibited butterflies and moths from Symonds Yat, including, among others, small Yellow Underwing, *Heliodes arbuti*, Scorched Carpet, *Ligdia adustata*, and speckled yellow, *Venilia maculata*; Mr. J. W. Neville, *Sternocera rugosipermis*, and *Chiloloba acuta*, two beetles from Burmah; under the microscopes Mr. Tylar showed silver ore from Utah; Mr. Moore, gizzard of ant, *Formica nigra*; Mr. Hawkes, *Ophrydium versatile*, also a series of objects illustrating the life history of the Alder-fly, *Sialis lutarius*; Mr. H. Hindmarsh then read a paper on "Weather and Weather Prophecies." The paper dealt with the unfavourable opinions of foreigners respecting it; erroneous impressions of the moon's influence; the difficulty of forecasting weather from our insular position; the effects of mountains, valleys, and oceans upon it; cyclonic storms; the use of telegraphy; application of the spectroscope, &c. The paper concluded with figures showing the percentage of predicted storms reaching our shores. June 23rd.—Mr. Hawkes exhibited a collection of plants from Rowington, including, *Plantago media*, *Habenaria bifolia*, *Sanicula Europæa*, *Geranium lucidum*, &c.; Mr. Deakin, a collection of mounted seaweeds, from Tynemouth; Mr. Sanderson, club-mosses, also specimens of peat from Whernside; Mr. Darley, the following moths:—Wood Tiger, *Nemeophila Plantaginis*, cinnabar, *Callimorpha Jacobeæ*, and burnished brass, *Plusia chrysitis*; under the microscope Mr. Moore showed eggs and larvæ of flea, *Pulex irritans*, and Mr. J. W. Neville, *Arcyria obtusatum*. June 30th.—Mr. Dunn exhibited, under the microscope, *Hydra fusca* with parasites; Mr. J. W. Neville, section of Dog-rose through a prickle. July 5th.—A Geological excursion was made to Dudley and the district; although the weather was somewhat unpropitious, a large number of members and friends assembled. The party was met at the station by Mr. Beale, who had kindly consented to act as guide. The route taken was to the Clay Croft Openworks, Mr. Beale pointing out on the way some rich fossiliferous formations; the thick coal seam was here examined, and its features described. The road was then taken to the Wren's Nest Hill, where some hours were pleasantly spent; a visit was afterwards made to the Dudley museum, where a vote of thanks to Mr. Beale for his kind assistance brought an interesting excursion to a close. July 7th.—Mr. Moore showed specimen of Mining Bee, *Andrena*, and nest of the same, also nest of Humble Bee, *Bombus terrestris*; Mr. Deakin, a specimen of Wryneck, *Yunx torquilla*, and eggs of Crow; Mr. Hawkes a number of plants, including *Atropa belladonna* and *Reseda luteola*; Mr. Madison, a case of shells, *Limnæa stagnalis*, including five sets taken from the same pond, extending over a number of years, and showing a gradual change of form; also shells of *Clausilia laminata*, *Paludina vivipara*, and *Bulimus montanus*, with models of their inmates; Mr. Darley, larvæ of Emperor moth, *Saturnia carpini*, and the following moths: Barred Red, *Ellopia fasciaria*, Pine Carpet, *Thera firmata*, and Shaded Broadbar, *Thera variata*; under the microscopes Mr. Foster showed section of fern, *Osmunda regalis*; Mr. J. W. Neville, section of shell of Pinna, showing prismatic structure; Mr. Hawkes, *Volvox globator*. July 14th.—Special, Botany; Mr. Hawkes exhibited a collection of plants, which included *Poterium Sanguisorba* attacked with rust, *Lecythea poterii*, and Brand, *Xenodochus carbonarius*, and *Tragopogon pratensis*, dwarfed with smut, *Ustilago receptaculorum*; also a specimen of Twayblade that had developed a third leaf; under the microscopes Mr. Tylar showed dotted vessels in oblique section of elm; Mr. J. W. Neville, Bladderwort, *Utricularia vulgaris*; Mr. Hawkes, spores of Burnet Brand.

PETERBOROUGH, NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—On Whit-Monday, June 2nd, a party of members and friends had an excursion to Helpston and Helpston Heath. Leaving Peterborough at 9 a.m. by Midland Railway they alighted at Helpston Station and proceeded to the village, the birth-place of the poet Clare. His house, his grave, and the handsome stone monument erected to his memory, were inspected, also the ancient stone cross and the church. The Heath was reached about noon, and after rest and refreshment, the members dispersed about the Heath and woods adjoining, and succeeded in obtaining a large number of plants, many of them rare, among them being *Orchis moria*, *O. mascula*, *O. latifolia*, *O. masculata*, *Habenaria bifolia*, *Aceras anthropaphores*, *Ophreys muscifera*, *Listera obata*. After a second rest, the party walked to Walton station, *viâ* Marholm, visiting the stone quarries *en route*, and reached Peterborough at 6-40, having spent a most enjoyable day.

TAMWORTH NATURAL HISTORY, GEOLOGICAL, AND ANTIQUARIAN SOCIETY.—On May 26th Mr. F. Lott delivered an interesting and exhaustive lecture on "Coal and its Origin;" the subject was the more attractive from the neighbourhood in which it was delivered, and was duly appreciated by an attentive audience. On June 16th a paper on the "Poetry of Science" was read by the Rev. Brooke Lambert, B.C.L. One of the largest audiences of the season met to hear it. The paper was short but suggestive. A desultory discussion followed on the relation of Science and Religion. Mr. W. G. Fretton had to postpone his lecture for the 14th July, owing to illness.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT PETERBOROUGH.

ADDRESS BY THE VERY REV. J. J. S. PEROWNE, D.D., DEAN OF PETERBOROUGH,

PRESIDENT OF THE UNION.

In the name of the Peterborough Natural History and Scientific Society, and as their President for the year, I offer a most hearty welcome to the delegates and members of the Midland Union of Natural History Societies who have honoured us by their presence to-day. It is with the greatest regret that I have to add, that I am unable myself to take any part in the meeting. Unfortunately an earlier engagement, and one from which I have found it impossible to escape, clashed with the time fixed for your gathering here, and for local reasons it was not found convenient to alter the date so as to admit of my delivering this address in person. It would have been a real pleasure to me could I have assisted in receiving the Union; for though I cannot put forth the smallest claim to any knowledge of Natural History or Science, yet I am not the less sensible of the great value of such studies and not the less anxious to do what I can for their encouragement. It is my consolation to know that there are members of the society in Peterborough who can more than make up for my deficiencies, and that you will, therefore, have no reason to regret my absence, sincerely as I regret it myself. I can only wish the meeting every possible success and every member of it the utmost enjoyment during the two days of their visit.

In considering what should be the subject of my address my thoughts naturally turned to the Cathedral. Under ordinary circumstances I should have had nothing new to say on such a subject. So many able and accomplished archæologists have given us the history of the Monastery and have discussed with infinite labour and learning every detail of the architecture, that little or nothing was left for a new comer on the field to glean. But within the last year and a half we have learnt a great deal about the central tower and the adjacent parts of the building which was not known before. We have been obliged to take down that tower, and in taking it down we have made considerable additions to our knowledge. Like many other misfortunes, this has turned out to be not altogether without its compensation.

Those who remember the condition of the lantern as it presented itself to the eye after the walls were scraped, and as it appeared from that time to the time of its demolition, will remember how it was torn and rent by gaping fissures, and must often have wondered how a building showing such signs of weakness could have held together so long. The condition of the two eastern piers added to the surprise. The north-eastern pier had been partially rebuilt by the 14th century builders; the south-eastern pier had been crushed and peeled by the weight above, and instead of being repaired had been strapped together with wooden uprights and iron bands in the most unsightly manner. Still till near the end of the year 1882 no danger was apprehended. Then a sudden and alarming movement was discovered to be taking place, and immediate action became necessary to save the whole from instant destruction.

Of course the lantern might have been preserved in its existing condition by underpinning and by tying its walls together by iron bolts as has been done in other cases, but the discoveries which were made in taking down the lantern and the piers gave convincing evidence that Mr. Pearson was right in deciding to take them down altogether and rebuild them. The walls of the 14th century lantern were merely rubble and dust, held together by the thinnest facing of Barnack stone. The Norman piers were no better. The core of the piers was dust and the bonding of the stone courses was wretched. The foundations were of the poorest kind, consisting of small stones laid on the loose gravel, though some two feet and a half lower down the builders would have touched the solid oolitic rock. Magnificent as the Norman architects were in design, they were not equally careful as to the soundness of their structure.

In taking down the tower and piers several interesting discoveries were made, of which I shall endeavour to give some account. But before I do this, it may be well briefly to state the facts with regard to the original construction of the tower and lantern, as we learn them from the ancient chroniclers.

The tower of the Norman Church was built by the Abbot William de Waterville, who also built both the transepts. "In suo etiam tempore (says Swapham) ambæ cruces Ecclesiæ, et tres hystoriæ (*i.e.*, stories which in more classical Latin would have been *tabulata**) magistræ turris erectæ sunt." Mr. Paley infers from this statement that there must have

* Paley.

been four stories in all, and that the fourth was added by the next Abbot, Benedict. If so, this central tower must have been a lofty structure, and as we know, it subseqently proved too heavy for the main piers on which it rested. I shall advert presently to the interesting fact that evidence of the existence of three stories in the Norman lantern has been found in taking down the 14th cenutury tower, but no evidence of a fourth. And although Mr. Paley not unnaturally inferred the existence of a fourth from the language of Swapham, "in his time . . . . three stories of the principal tower were erected," yet there is no mention anywhere, so far as I am aware, of the erection of a fourth, and I am inclined to think that the fourth was only designed but never erected; unless, indeed, the words of the chronicler may be rendered (which considering the character of the Latin seems not impossible) "*the* three stories of the main tower were built."

No sooner was the demolition of the 14th century lantern begun, than it was seen that the builders of that period had worked up the old Norman material in the construction of their own tower. On removing the stones of the somewhat richly adorned string-course on which the parapet rested, the stones composing it were discovered to be mostly the caps and bases of the internal arcades of the various stages of the old Norman lantern, these being so disposed that the original carved faces were turned inwards, whereas the ends which had been at first bonded into the wall were now exposed and ornamented with the new 14th century moulding. As the work of demolition proceeded, it turned out that the mass of the stonework, with the exception only of parts of the belfry window-jambs, was the old Norman material re-worked and re-moulded, and (such was the excellence of the Barnack stone) as fresh and sharply cut as when it was placed in its original position. The walls, however, of the lantern were of the poorest possible construction. There was a facing only of the Barnack rag varying in thickness from about two to six inches, and the whole of the rest of the walls was composed of small fragments, many of them not larger than a man's hand, embedded in rubble and stonedust, or as it is locally called "pit mortar."

Towards the upper part of the lantern the filling in of the wall presented curious fragments of earlier and later work, bits of decorated carving, pieces of marble shafts—perhaps from the west end,—one of the large keeled angle stones from the west front which had been placed in the extreme angles north and south, and portions of decorated plaster screen work, carved, and ornamented with black plaster inlay. There was also found a very large quantity of fragments of monumental cross slabs of Early English and decorated work, some presenting good and elegant designs, and two curious foot-stones, with incised line double crosses. Several of the window-jamb stones had been wrought out of these, the words "HIC JACET" being plainly discernible on one of them; and this use of tomb-stones was carried so far as to include the use of stone coffins for ashlar in two or three instances.

As I have already observed, very considerable remains of the old Norman lantern have been recovered, and the history of the "three stories" of the "master tower" has been fully made out.

First, there are the bases, caps, jambs, and arches of what appears to have been the tower stage or third storey which was shielded from the light on all sides by the then roof.

Secondly, almost all the caps, bases, and parts of jambs, arches, and pillars of what formed the second internal stage (or third, if four existed) and also quantities of the jambs and external arcades as well as of the small blank arcades over them,—a feature similar to what is seen on the present transept gables.

Thirdly, there are considerable quantities of the caps, jambs, arch orders, &c., of the upper stage. This on the interior presented a design of three arches, precisely as in the windows of the clerestory on the east side of the transepts, and like these had probably a small blank arcade above on the exterior.

Further, large portions of the richly zigzagged string over the Norman arches of the crux have been found, as well as of the two moulded strings over it; and also fragments of the shafts at the angles of the interior and of the attached half columns which formed the interior upright division lines of the composition.

In a similar way a great quantity of the external strings and half pillars has come to light. Of the outside woık a part still retains the lichened coating with which it became covered when it was in its original position.

It is well worth considering whether in rebuilding the lantern it would not be desirable to make some use of this Norman arcading. There is enough, or nearly enough of it, to reconstruct the whole of the lower or first stage immediately above the arches of the crux. If this is thought desirable, and I confess it appears to me very desirable, there would be no structural difficulty in the way. The arcading would be quite complete above the two Norman arches on the north and south sides; it would be intersected by the pointed arches on the east and west sides of the crux. There would be no interference with the general character of the lantern. It would still tell its tale of the 14th century reconstruction,* and there is no reason why there should not be added to this the tale of 19th century rebuilding.

The addition of this stage of arcading would of course raise the tower to the extent of the height of the arcading. On this, the 14th century tower might still be re-erected. But can nothing more be done? Such a tower would still be low and out of proportion to the great length of the church. Surely something more might be done and a spire would be a grand feature. There are spires on two of the western towers; there was, as late as a century ago, a third spire. To erect a lofty and noble spire on the great central tower would be a triumph of architectural skill and would give a dignity and an elevation to the church which nothing else could impart.

I am sorry that I cannot agree with Canon Owen Davys in thinking that the 14th century builders purposely kept the central tower low, whilst they added spires to the western towers in order to concentrate the whole external effect of the church in the west front. It is quite clear, on the contrary, and abundant evidence to the contrary has turned up in the course of taking down the tower, that the architects of that day endeavoured to rebuild the Norman lantern, but were obliged to desist owing to the unsound condition of the piers. They made two attempts at rebuilding, the one closely following the other. Mr. Davys writes: "The *Norman* idea was that of a lofty central tower with two smaller western towers, as at Southwell, but the *Early English* builders had since given such unlooked for dignity to the west front that now the Continental idea of western splendour and central lowliness might well be adopted. So two leading thoughts directed the new design; the first to build a tower so light as to avert future danger; the second to build a tower so low as not to divert the eye from the west front. In both these efforts as the towers left the hands of the builders they were eminently successful."—(*Guide to Peterborough Cathedral*, fifth edition, p. 63.)

I quite agree with Mr. Davys as to the first of these reasons for a low tower. I can see no ground whatever for attributing the second to the *Early English* builders. Certainly I know of no view which can be obtained of the west front

* I must say frankly, however, that I see no reason why these two pointed arches should be retained if the Norman arcading is restored.

where a lofty tower or spire would so dominate it as to interfere with its imposing majesty.

The excavations which it was necessary to make at the bases of the piers of the central tower, in order to test the state of their foundations, led to a very interesting discovery. At the foot of the south-eastern pier were found the remains of a Saxon building, doubtless the church of the ancient monastery. This church was destroyed by the Danes when they attacked the monastery in 870. The Abbot John tells us in his Chronicle that when they came to Medeshamstede, the Danes found the inhabitants of the neighbourhood collected beneath the walls of the monastery, which were of such strength that they were obliged to attack them with engines, and cover their approaches with archers. Enraged at the obstinacy of the defence, and especially at the death of his own brother, the Danish leader slew all the monks with his own hand, desecrated the shrines, trampled under foot the relics of the saints, and set fire to the monastery, which was entirely consumed, the fire continuing to rage for fifteen days. And now, after the lapse of a thousand years, the disinterred walls show traces of the action of the fire. The stone tells the story of the destruction. The intense heat to which it has been subjected has changed the colour, and in some portions has left the edges cindery and friable. The walls now exposed to view are of no great thickness, and were probably never of any great height, the upper part of the building having doubtless been of wood. First of all there was laid open to the north of the pier a wall, or rather two walls, with a narrow space between them running east and west. These walls, as has been said, are slight, and the method of their construction and arrangement confirms the supposition that they were intended to carry a wooden superstructure. Beyond these to the north was evidently open ground, a short wall at right angles to the others coming there to an abrupt termination; whereas on the south side and west of the pier, at a depth of some six feet below the level of the present Cathedral, the workmen came upon the plaster floor of the ancient building. This was again reached in the south aisle, and extended in all probability to a considerable distance west and south. In the south transept the floor can be followed eastward to a plaster seat placed at the extremity of the building against the external eastern wall. Here it is plain that the limit of the building eastward has been reached, because in the open surface beyond a massive stone sarcophagus is standing, obviously of much more recent date. The lid of this coffin is of uncommon thickness, but at present it is impossible to open it, or, indeed, to examine it carefully, as the huge woodwork on which the steam-cranes are supported rests on the floor above. Indeed, only a portion of the tomb is visible.

How far the remains of this Saxon building extend, and whether the lines of walling indicate the existence of one or more than one building, it is at present impossible to determine. This can only be done when the immense shoring and scaffolding which have been erected for the demolition and reconstruction of the pier have been removed. Unfortunately as the pier stood directly over a portion of the Saxon building it was necessary to destroy some part of it in digging the foundations for the new pier.

If I am right as to this discovery, if we have here come upon the remains of the old Saxon church, then it is quite plain that Mr. Poole is wrong in his conjecture that the Norman church was built on the lines of the old Saxon church. He says, "In substance, I believe, the Abbot John of Sais (who laid the foundation of the existing presbytery, in March, 1117) found the same monastery and especially the same church which Saxulfus had built and Ethelwold restored. Indeed, I suspect that a very large portion of the Saxon church existed until the present nave was built by Abbot Benedict. From that time no visible traces of it remained above ground." And of Waterville, who built the tower and the transepts, he remarks, "His transepts were built in all probability on the foundations of the Saxon transepts, which he removed to make way for them; but with this difference, that the Saxon transepts had aisles both east and west, the Norman only to the east." And again (p. 203), in reply to Mr. Paley's argument that Waterville must have extended his work west of the central tower because "so large and heavy a tower *could not* have stood safely without some considerable abutments against the pillars at the west side," and that hence, "two or three nave arches, with their triforia and at least one bay of the clerestory would be essential for sustaining the fabric." "Granted," he says, "if the fabric had not already a sufficient support; but you will remember that we have no reason to doubt that the Saxon nave yet remained, so that the support was there already." All this argument, however, falls to the ground if the building recently disinterred was any part of the old Saxon church. It could never have been used as an abutment to the Norman towers. In fact, even if the Norman building had followed the same lines, the upper portion of the Saxon church being of wood, nothing but the low stone walls on which this rests would have been left and these calcined by the fire. There was, however, an earlier *Norman* church than the present one, that of Abbot Ernulph. This was burnt down during the abbacy of John de Seez (or Sais), and he it was who built the present choir.

I am able to throw some light upon another question, the probable existence of a crypt under the church. Gunton tells us: "At the south end of the north aisle near the choir is a vault descending into the ground by stairs of stone, and at the bottom a low arched passage going under the church, wherein anyone might go some five or six yards and there find the way stopped with the fall of the earth over head; but how far further this vault went, or to what end it was made, I never could learn. Happily it might lead to some penitential purgatorian place; or, like *Mortimer's Hole*, at *Nottingham*, be a subterraneous passage to some other buildings which are now perished." On this Mr. Paley remarks, "Similar crypts, and in the very same place, exist at Ripon and Hexham. It was, without doubt, part of the old Saxon church. In 1817, a wall with a subterraneous archway leading towards the church was opened at the base of the mound called Tout Hill, on the north side of the church. There may have been a connection between these two singular and mysterious passages."*

Following the direction of Gunton, I have had this vault excavated. It lies just midway between the north-east and north-west piers of the lantern, Gunton meaning by "the south end of the north aisle," the south end of the north transept. It consists of a small entrance chamber and a winding passage trending first from south to north and then to north-west and west. Portions of a stone pavement, some three inches thick, remain in a state of excellent preservation. This is at a depth of 5ft. 6in. below the floor of the present church. But it is obvious at a glance that this was no part of the Saxon building. The walls of the passage and of the chamber are of excellent and finished masonry, apparently of Early English date, the chiselling of the surface being finer than the Norman, and being vertical and not diagonal as in the Norman work. The mason's marks upon the stones, a bow and arrow in one place and a triangle in others, are quite plain and distinct. The wall on the south side of the chamber runs in a straight line east and west, and was kept no doubt in a line with, and just behind, the stalls which in the old Benedictine Abbey Churches were carried across the transepts, the screen being placed in the nave, two bays below

* Mr. Poole is also disposed to look here for the crypt of the Saxon church. See his paper, read at a meeting of the Architectural Societies of the Archdeaconry of Northampton, &c., May 23, 1855.

the central tower. This chamber is 5ft. 9in. by 3ft. 2½in., and has traces of steps both on the eastern and western sides, the latter being somewhat worn and broken away, whilst the edges of the former are still clean and sharp. The passage leading from this chamber goes first at right angles to it, and, after a short distance (some 5ft.), turns sharp at an angle of a little more than 45deg. to the north-west, and then again to the west, and comes to an abrupt termination. Here there are indications of an arch. The passage at the end near the steps is 2ft. 10¾in. in width, but becomes narrower after it turns, and at its western extremity is only 1ft. 9¼in. in width. The ground beyond this has been excavated for the foundation of the new north-western pier, and it is certain, therefore, that the passage does not extend further in that direction; but just there were discovered two leaden pipes, of 2in. lead, running westward, which, it is conjectured, were used for conveying water from an old well just outside the church. The entrance to this passage was unquestionably by the steps above mentioned. Unless, therefore, the passage was made for access to the pipes, we can only conclude that it was intended to be the approach to some subterranean building, the construction of which was afterwards abandoned, and the unfinished arch at the end of the passage westward may favour this view as well as the other. At the first angle of this zigzag passage, counting from the entrance, there are some indications of another passage to the north-east. The masonry, however, comes almost immediately to an abrupt termination. Otherwise in this direction we might have expected to find the conduit which is said to have brought the water from a well at the foot of Tout Hill to the Cathedral (Paley). The chamber through which the entrance lies, it has been conjectured, was intended as a place of security for the treasure of the church, but this does not seem to me to be probable. The chamber is somewhat larger than the passage, merely because here was the entrance. The descent to it was by stone steps. On the eastern side there are indications of a complete staircase. On the other side there is no evidence of more than two steps, and these have been partly broken away. It is plain that they originally extended across the recess, and there was doubtless a double flight of steps. On the floor, where the steps are broken away, several fragments of iron were found. These might support the theory of a chest having been kept there for relics, or that of a dungeon or place of penance for refractory monks, suggested by Gunton, were it not so evident that this was only the entrance. A skull and some other human remains were found in this vault, and also several fragments of an ancient stone reredos, the gilding and colouring of which were remarkably fresh and bright when they were first discovered. It must have been a beautiful work of art, either of pointed or early decorated design. Unfortunately no two fragments seem to fit each other, so that it is not easy to restore it even conjecturally.

When speaking of the Saxon building I ought to have mentioned that in the foundation or interior of the eastern piers a few fragments of Saxon moulded work were found, such as perforated slabs of windows, door jambs, and lintels, and one very interesting and richly carved fragment of a capital, almost unquestionably Roman. This may have been brought from Castor, but it is curious that no other fragment of Roman work has been discovered. All these relics of various ages and workmanship have been carefully preserved and will be shown by Mr. Irvine, the Clerk of the Works, to any members of the Union who may wish to inspect them.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER II., PART II.

BY W. W. COLLINS.

Development.

At the commencement of this extremely interesting chapter, Mr. Spencer is careful to point out in a foot-note that in ordinary speech Development is often used as synonymous with Growth, hence it is needful to say that Development as here used means increase of structure and not increase of bulk.

Development is primarily central, every animal and every plant setting out in its earliest stage with a symmetrical arrangement of parts round a centre. Indeed, in organisms of the lowest grade no other mode of arrangement is ever definitely established. Examples of this type of structure may in the vegetal world be seen in the Uredo and several tribes of the Protococci, while in the animal kingdom it is exemplified by the Amœba, Actinophrys, and their allies.

Central development is distinguished into Unicentral and Multicentral, according as the original product develops symmetrically round one centre, or without subordination to one centre develops in subordination to many centres. The Thalassicollæ of the southern seas represent among animals Unicentral development, while in the realm of plants it is exemplified, though feebly, in the Volvox globator. Multicentral development being far more general is variously exemplified in both the animal and the vegetal kingdoms.

From Central development we pass to that higher system of arrangement which Mr. Spencer terms Axial development, and this kind of development is of two orders, viz., Uniaxial and Multiaxial; examples of both being found in each division of the organic world. Multiaxial development occurs in all the higher types of vegetal life, while in the animal kingdom it prevails only among the lower types, all the higher orders being examples of Uniaxial development.

Both Axial and Central development may be either continuous or discontinuous. Among plants continuous Multiaxial development is the rule, and as instances of it among animals may be mentioned all the compound Hydrozoa and Actinozoa.

From these general aspects of development we are led to the more special aspects. The gradual unfoldment of the bud of any plant to the leaf-bearing shoot is a passage from the incoherent, indefinite, homogeneous, to the coherent, definite, heterogeneous, and the same applies exactly to the development of the arm of a man from its bud stage. In both cases the original is simple, and having much in common with countless other forms, increasing in complexity by slight differentiations, they gradually obtain increasing unlikeness to other forms.

In their earliest stages all organisms have the greatest number of characters in common with all other organisms in their earliest stages, but in later stages the characteristics displayed by each structure correspond with a less extensive number of organisms; step by step these resemblances are diminished until they are finally narrowed down to the members of the same species. Thus while we may not believe that man passes through stages which resemble the adult forms of lower organisms, we may say that the embryos of both man and the lower organisms (the fish for instance) present in certain stages characteristics in common. And while we cannot say that a man was at one time a fish, or a reptile, we may with truth assert that he passes through the piscine and the reptilian into the mammalian stage.

The next great fact we notice is that in each successive stage passed through by any higher organism there is a corresponding modification in the relationship between the organism and its environment. If we note the structure, form, specific gravity, chemical composition, or temperature, we shall as we ascend the grades of organisms find them more and more distinguished from their inanimate media. Thus the development of an individual organism is at the same time a differentiation of its parts from each other and a differentiation of the consolidated whole from its environment.

The growth of an organism is carried on by the abstraction from the environment of substances like those of which the organism is composed. In like manner the development of the organism, the production of each organ within the organism, is carried on by abstracting from the substances contained within the organism those required by the particular organ.

From all the facts of development we deduce the great and important generalisation that development is a change from incoherent, indefinite homogeneity, to coherent, definite heterogeneity, and the profound principle Evolution receives further confirmation.

SUNSETS IN AUSTRALIA.

The sunsets have been magnificent here, even quite lately; but the displays are now intermittent and usually occur during times of high barometer. I have taken throughout a great number of observations, but have failed to establish a satisfactory connection between the "glows" and other meteorological factors prevailing *at the earth's surface*. That the glow is not due to vapour primarily, as suggested by Mr. Ellery, of Melbourne, seems certain. On occasions of magnificent displays I have had a perfectly sharp "clean" spectrum, without a trace of vapour-bands. Vapour condensed by dust particles may, however, "manipulate" the glow. Often in the forenoon the pink effects have been visible, even a few days ago; and at sundown, under conditions of high pressure, the display well-nigh baffles description, bathing the landscape, with its white-trunked gum trees, in tints so weird that one is tempted to imagine he is living on some other planet. Some ten days ago an intense burning glow was reflected from the western sky for fully an hour after sundown, giving one the idea of an African picture on the approach of the simoon, while opposite the full moon was rising over the lofty ranges against a lovely sky of a deep sea-green. The combined effect on houses, trees, etc., must be left to the imagination to portray. I am strongly of opinion that the Krakatoa eruption is the first cause of these wondrous pictures in the Kosmos; and I think I see a way of escape from the difficulty *re* the displays appearing a fortnight later in India and Ceylon than in Western Africa. We must remember that the eruption took place in a zone of low barometer. *Over* this, apart from differences of altitude, there would be a relatively higher or accumulated pressure caused by the ascending currents. At least, such a state of matters prevailed at Ben Nevis during low pressure periods. Well then, the piercing and tearing asunder of the atmosphere over that mighty Javan furnace, and the force of the eruption, would be the means of the minute dust particles being ultimately safely landed on the top, as it were, of the upper high pressure. They would afterwards be buoyed up and play over the currents like the "willow-leaves" in the sun, changing their altitude from time to time with barometric variations. By the rapid rotation of the earth at the equator an easterly upper current would bear the dust westwards; and the high pressure above the low pressure over the Asiatic land at that season would not allow the dust to make much of a northerly course. On the other hand, the overflow of dust from the main westerly stream would be in a southerly direction where low pressure prevailed *over* the surface high pressure of the great Indian Ocean. I am hurrying for the mail, and trust I have sufficiently explained my meaning; and other notes *in re* may follow in course.—Clement L. Wragge, Torrens Observatory, Adelaide, South Australia. July 17, 1884.

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 220.)

l.—Heliotropism.

The stem and swelling vary much in appearance according to the circumstances under which they grow. They are very heliotropic, and bend energetically towards the side from which the light proceeds, if grown before a window. I have grown *P. Kleinii* in a dark room, to which only a feeble ray of light penetrated through a narrow crevice, and under these circumstances the stem was very much drawn up, being sometimes three-quarters of an inch in length or more, though its ordinary height is under one-tenth of an inch. But the diameter of the stem was then much less than usual, the swelling was attenuated, and the whole fungus almost colourless, except for the spores and the black cap. This property of heliotropism is not universal among Fungi; it is possessed by some, but not all, species of Mucor, while some of the allied genera are altogether wanting in it. M. Woronin records an interesting experiment which he performed on *Sordaria fimiseda.** The neck of the perithecium of this species bends towards the light, and, by growing it in light proceeding from one side only, and turning it round at intervals, the neck may be made to form itself into a zigzag (or spiral), changing its direction three or four times. All the species of Pilobolus seem to be affected in the same way, and I have often caused the stem to grow with a double curvature, by turning round the plate on which it stood before a window.

m.—Periodicity of Growth.

Another point deserving of consideration in the physiology of Pilobolus is the duration of its growth. It is the Ephemeron of plant life. Each individual stem lasts, under normal conditions, only one day. But what is still more surprising is that it goes through its various stages with almost the regularity of clockwork. Each afternoon, about 3 p.m., the surface on which it is growing is studded with a number of minute subulate yellow points; these are the young stems. By 5 p.m. the sporangia begin to form. During the evening the upper septum is completed, the cap of the sporangium assumes a darker colour, passing through olive to dark brown; at the same time the swelling begins to appear. Then during the night the spores are completely elaborated, the cap assumes its ultimate thickness and blackness, and the swelling reaches its full size. Early the next day, the surface, which last night we had left covered with a number of tiny black-headed pins, is seen sprinkled as it were with diamond dust, each swelling brilliantly glittering in the beams of the morning sun. This, however, is a sight reserved for the "early bird." As

* "Beiträge zur Morph. und Phys. der Pilze," ser. iii., pp. 9, 10, pl. ii., figs. 12, 14; pl. iii., fig. 7.

the day advances the fungus completes its growth, and about noon is ready to throw off its sporange. In the afternoon, when the next crop is beginning to appear, nothing is left of the previous one except the withered and dying stems.

While contemplating the saucer in which I grew my specimens, after listening to the mimic bombardment which raged so furiously an hour before, standing as it were on the field of battle with nothing but dead and dying soldiers stretched around me, I have felt as Wellington might have felt after Waterloo, but with a consolation denied to that gallant hero. I knew that even then around my feet another army was growing up among the mangled remains without any help from me, and would be ready the next day with full equipment to march with me to victory again.

The normal course of development, however, may easily be disturbed by a change of circumstances. If there be sufficient moisture and nutriment present the growth proceeds with regularity, but, if we remove the specimens into a drier atmosphere, we may retard it to a considerable extent. You will see that it is difficult to make sure of specimens to exhibit at an evening meeting, unless you remove them in the morning into a place where their growth will be stopped, and the simplest way is to take them from beneath the bell-glass and place them in the dark. If we grow the Pilobolus altogether in a dark room it soon loses count of the time, and immature or full-grown sporangia may be found at all hours.

n.—Modes of Multiplication.

If the sporangium falls into a suitable place the gelatinous substance is gradually dissolved by water, and the spores escape and germinate. But it is not by this means that the successive crops of Pilobolus are produced, but by a kind of prolification of the mycelium, which continually sends out fresh branches, from which new stems proceed. In fact, the whole of the membranes appear to possess this reparative power. If the first growth from a basal reservoir be injured it sends out a new stem from some other point; if the top of a growing stem be injured it forms a septum just below the injured part; a new stem grows out from the side of the old one (Fig. 5) and may mature its sporangium. Van Tieghem has shewn that, if even the spores of *P. œdipus* be injured or broken in pieces, each fragment will germinate by itself, and produce a mycelium.*

* Troisième Mémoire, pl. 10, fig. 1. See also Nouvelles Recherches sur les Mucorinées, pp. 19-24.

Klein has attributed to the species named after him that its spores, under certain conditions, gave rise to a Mucor, in fact to *two* distinct species of Mucor;* but it is obvious that his experiments were quite untrustworthy and misleading in this respect, and Van Tieghem has finally disposed of the claim by his observation that the spores of *P. Kleinii* will not germinate at all under the conditions which Klein employed.

Coemans has described and figured a conidial fructification produced from branched hyphæ, growing on the basal reservoir of *P. œdipus;* the conidia were orange(?), oval or oval-fusiform, 7—18μ long; other authors have considered that these did not really belong to the Pilobolus, but this is not certain.

Saccardo † describes and figures chlamydospores of *P. œdipus*, from New Jersey, U.S.A., which he considers identical with the *Mycogone anceps* figured by Coemans; ‡ they are "globose, 20μ in diameter, or ovoid, 30—35μ by 20μ, often septate below, and slightly constricted, granular within, orange. Hyphæ dichotomous or loosely branched, creeping, septate, yellow." §

Roze and Cornu ‖ found stellate chlamydospores on *P. crystallinus*, which were borne on short lateral recurved branches of the mycelium within the matrix; membrane thick and yellowish. Van Tieghem, finding similar bodies in *P. nanus*, placed the physical continuity of the chlamydospores with the Pilobolus beyond a doubt; their diameter varied from 15—20μ. The chlamydospores of which Coemans speaks, which I have also met with, belong to an Ascobolus.

No zygotes have yet been discovered in Pilobolus. The organs mentioned by De Bary doubtfully under this name ¶ are of another kind.

o.—HABITATS.

The species of Pilobolus are found chiefly on the various kinds of dung, though also on other decaying substances; and on mud containing probably a quantity of putrefying matter. Baker found his on the black mud of the Thames; Scopoli describes his specimens as growing on the larvæ of Sphinx Atropos, preserved in soil; Cohn discovered *P. œdipus* on a layer of decaying Oscillaria

* Zur Kenntniss des Pilobolus, Part III.
† Michelia, ii., 372; Fungi Italici, 866.
‡ Spic. Mycol., p. 11, fig. 5.
§ Michelia, *l.c.*
‖ Bull. Soc. Bot. France, 1871, vol. xviii., p. 298.
¶ Morphologie der Pilze, p. 179.

which covered the surface of the water of a glass in which he had been growing that Alga, and a friend of his found the same on the mud of the Oder. But the most frequent habitat is the dung of various animals, as of horse, cow, sheep, pig, deer, elk, roebuck, rabbit, cat, goat, dog, goose, all of which are mentioned by various authors, and even the excrement of man himself.

§ 4.—Pilaira.

Pilobolus is one of the highest types of the Mucorini. Its distinguishing feature is the basal septum, without which the tension necessary to the projection of the sporange could scarcely be attained. It may be called a three-celled plant, as distinguished from most other Mucorini, which are, *individually*, essentially only two-celled, although, of course, this is only partially true. In the genus to which we now proceed, Pilaira, which forms an exact connecting link between Pilobolus and the Mucoridæ, the general structure, especially of the sporangium, is the same, but with one important difference. The septum at the base of the stem is wanting; the stem is merely an erect branch of the mycelium and is continuous with it. In correlation with this difference we find that there is no swelling at the top of the stem, and that the sporange is not explosively projected. This furnishes a new proof of the truth of that theory of the cause of the projection which has been given above.

The sporange of Pilaira has the same thickened black upper hemisphere as Pilobolus, and the same diffluent zone. The dehiscence therefore takes place in the same way. The interstitial gelatinous substance swells up, on the application of moisture, to even a greater extent than in Pilobolus. But the sporange is not projected. We conclude, therefore, that the cause of the projection in the former case lies in the points of difference between the two genera; and these are precisely the absence of the swelling and of the septum.

But still the species of Pilaira hitherto described secured a certain amount of dissemination of their spores in another way. The cylindrical stems rise to a considerable height, in *Pilaira Cesatii* reaching even four or five inches, and when mature become flaccid and quietly deposit their sporangia at a greater or less distance. But in a new species described in the sequel, the stem does not attain so great a height, being at first usually from $\frac{1}{25}$th to $\frac{1}{20}$th of an inch, and thus it is deprived of both those means by which its allies disperse their spores.

The columella of Pilaira is somewhat different from that of most of the species of Pilobolus. This form of columella is not essential to the genus as defined, but it is interesting to notice that the same columella is met with in the new species, even more markedly than in the two previously described. The chief difference arises from the fact that the columella of Pilaira is inserted, not at the place where the terminal sphere joins the stem, but at a higher level, as it were *within* the sporange. But I think, in order to be consistent, we must regard the swollen portion below the columella as belonging to the stem, and confine the term "sporange" to the cavity included between the columella and the upper hemisphere; though there are difficulties in either view. The swelling below, which is called the *apophysis*, is not homologous with the swelling of the Pilobolus stem, since it is formed at the same time as the sporange.

The only species of Pilobolus in which a similar columella is found is *P. nanus*. Here also the columella arises within the sphere, somewhat above the point of junction with the swelling, and thus leaves an apophysis below the sporange. It should be remarked that in this species, as in Pilaira, the fine acicular crystals of oxalate of lime, which usually encrust the sporange, extend even to the apophysis, which would seem to show that the latter is in certain respects more closely related to the sporange than to the stem.

It has been already mentioned that the stems of Pilaira grow to a considerable height. But the sporange is first formed when the stem is short, and is raised afterwards by an interstitial growth of the stem, such as is frequently met with in Mucor. This interstitial growth takes place chiefly in the part immediately below the apophysis, and Brefeld suggests, with great probability, that it is the homologue of that process by which the swelling of the stem is produced in Pilobolus.

No chlamydospores, or other asexual modes of reproduction besides the sporange, seem to be known in Pilaira, but on the other hand we meet here with a sexual reproductive process, such as is known in the Mucors, but has not yet been ascertained in Pilobolus. Both Van Tieghem* and Brefeld† obtained these zygotes; the former cultivated them from the spores, thus observing their early development, and the latter observed their germination. I will give a short abstract of their accounts, although I have not myself met

* Nouvelles Recherches, pp. 57-8, pl. 1, figs. 22-4.
† Botanische Untersuchungen, iv., 65, pl. 4, figs. 26-8.

with these zygotes, which both the before-mentioned observers considered to be very rare, each having met with them on only one occasion.

The spores, which Van Tieghem sowed in a pendent drop of nutrient liquid,* in a closed cell, germinated and produced a shortly ramified mycelium. Two days after conjugations were observed between neighbouring branches; two short lateral ramuli (which even in some cases proceeded from the same branch of the mycelium), growing in a flexuose manner, twined round each other a few times, and their free ends, swelling somewhat and curving towards one another, came into contact. The terminal portion of each was then separated from the rest by a septum, the two cells thus formed being constantly unequal. These became more and more closely united with each other, the intervening membrane disappeared, and their protoplasmic contents were mingled. The zygote thus formed surrounded itself with a thickened membrane, which became black and smooth; they reached a size of about 40 μ, but did not develop further.

Brefeld found his zygotes already fully developed on horse-dung, on which the fungus was growing luxuriantly. They were black, of an oval form, 100 μ by 120 μ, and covered with little warts; when ruptured they were seen to enclose, within the blackened exospore, a thick-walled, smooth endospore, and within that a dense protoplasm. After lying for four weeks on damp paper they germinated, giving out a tube which immediately produced the ordinary sporange of a Pilaira.

PART III.—CHEMICAL REACTIONS.

Of these, to which I have paid little attention, I will only mention a few. A solution of iodine in potassic iodide imparts to the stem of Pilobolus a beautiful rosy tint, passing into reddish purple with a stronger solution, a reaction which is very characteristic of the Mucorini. Iodine colours the spores at first green, then brown. Thus if a spore-mass, unbroken, be treated with iodine solution, the reagent penetrating gradually inwards, but not reaching the centre, where the orange spores still remain in their normal tint, produces concentric shells of colour which have a very pretty effect. Strong sulphuric acid removes the dark (sometimes brown, sometimes violet-black) pigment from the cuticularised membrane of the sporangium, causing it to

* The liquid used was a decoction of dung.

assume a pale transparent brown colour. The same reagent causes the spores to swell up into a roundish mass, bounded only by a faint contour, while the colouring matter which was dissolved in the spore contents is reconcentrated in granules.

Under this head I may place the curious dichroism of the yellow colouring matter of the protoplasm, which by reflected light is of a pure golden yellow, but by transmitted light appears of a rich red or red brown tint.

(*To be continued.*)

THE PRESERVATION OF NATIVE PLANTS.

We have been requested by the Hon. Secretary of the Midland Union of Natural History Societies (Mr. T. H. Waller, B.Sc.) to publish the following :—

At a Meeting of the Management Committee of the Midland Union of Natural History Societies, held July 30th, 1884, the subject of the extermination of rare plants was introduced by Mr. A. W. Wills, who read the paper which has since appeared in the Midland Naturalist, and the following resolution relating to the Swiss Society mentioned in it was carried unanimously :—" The Committee of the Midland Union of Natural History Societies, deeply regretting the extermination of many of the native plants of Switzerland, desires to express its sympathy with the Société pour la Protection des Plantes, and to pledge the members of its own Societies to contribute, by all means in their power, to the cause of the preservation of the native flora of that glorious land which has been the resort and the delight of so many of themselves and of their countrymen."

Action on Plants of Rain, Dew, and Artificial Watering.—From numerous experiments by Professor J. Wiessner (*Bied. Centr.* 1883, p. 471) it has been found that the moistened leaves of plants transpire much more freely than when they are in a dry condition; therefore a larger quantity of water is then withdrawn from the soil by the roots of the growing plants. Consequently if there is plenty of moisture in the ground the plants flourish, but if otherwise they droop and languish. From this fact the Professor argues that plants should not be watered on the leaf unless the soil is likewise moist. The small amount of extra transpiration induced by dew he thinks can do no harm, as it is almost certain that the ground will at the same time be sufficiently moist to supply to the growing plants the requisite amount of water. The action of rain is proved to be by far the most beneficial to the plant, as by its aid the supply of plant food becomes the most rapid.—*Gardener's Chronicle.*

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(*Continued from page 225.*)

LEMNACEÆ.

LEMNA.

L. trisulca, *Linn.* *Ivy-leaved Duckweed.*

Native: In ditches, canals, and pools. Locally abundant. Not yet observed in flower.

I. Sutton Park; Green Lanes near Coleshill; Bannersley Pool; pond on Baddesley Common; pool near High Ash, Kinwalsey; pool by Water's Wood, Maxtoke; pond near Barber's Coppice, Hampton-in-Arden; pond near Balsall Mill; Earl's Wood; pools and ponds, Shirley Heath.

II. In a deep pool at Stivichall! stagnant water on Stoke Heath; near Arbury Hall, *Kirk*, *Phyt.* ii., 971; Honington, *Newb.*; old canal, near Rugby; canal, Newbold-on-Avon; Binley Common; Sowe Waste Canal; Willoughby; Birdingbury Wharfe; pool near Flecknoe; pool near Farnborough; Fullbrook; Rounsel Lane; pool near Tile Hill Wood; pool on Wawens Moor.

L. minor, *Linn.* *Least Duckweed.*

Native: In pools, ditches, canals, streams, &c. Very common. July. Area general.

Only rarely observed in flower, and then only in isolated individuals.

L. gibba, *Linn.* *Gibbous Duckweed.*

Native: In pools and ditches. Very local. Rare in flower. July.

I. Hampton-in-Arden, *Rogers*; Sutton Park, in flower 1878; ditch near Minworth; pool, Coleshill to Bannersley, in flower 1870; small pond, foot-road from Coleshill Church to Maxtoke Park; Duke's Bridge, Maxtoke; cattle pond, Bradnock's Marsh.

II. Mill pond near St. Nicholas' Church, and in a brook in Baly's Lammas, Warwick, *Per. Fl.*; three ponds near Lawford and Newnham, *Blox. N.B.G.*; ditches and ponds near Foleshill; in a pond near Berkswell, *Kirk*, *Phyt.* ii., 971; Rounsel Lane, Kenilworth! *H.B.*; Spernal Ash, abundantly in flower 1878; Sowe Waste Canal, in flower 1883; pond by Long Itchington.

This plant, when it does flower, is usually in abundant flower.

L. polyrrhiza, *Linn.* *Greater Duckweed.*

Native: In ditches and pools. Rare. Not observed in flower.

I. Pool in lane near Hams Hall, *W. B. Grove*; roadside pond near Bacon's End, Coleshill; pools near Escole's Green; small pool, Druggett's Lane, Berkswell; Solihull, near the Railway Station; pool near Hartshill, on the Mancetter Road.

II. Near Radford; ponds near Stoke Heath, *Kirk*, *Phyt.* ii., 971; Burton Dassett, *Bolton King*; pond in Rounsel Lane, Kenilworth, *H.B.*; pond in field, path from Marl Cliff to Bidford; pool near High Ash Farm, Morton Hill; cattle pond, Combe Pastures, near Coventry; near Carroll's Green and Hearsall Common, abundantly; near Flecknoe; Woodloes.

Both this species and *L. gibba* are uncertain in their appearance, and will often be missing for one or more seasons in any of the above localities.

NAIADACEÆ.

POTOMOGETON

P. natans, *Linn.* *Floating Pondweed.*

Native: In rivers, streams, pools, ditches, and canals. Locally common. July to September, Area general.

P. polygonifolius, *Pourret.* *Oblong-leaved Pondweed.*

Native: In ponds, streams, ditches, and marshes. Local. June to August.

I. Annesley coalfield heath! *Rev. A. Blox.*, *Phyt.* iii., 324; Astley Heath! *Kirk*, *Herb. Perry*; Sutton Park, abundant; pit by New Park, Middleton; pond near Springfield House, Ansley; Bannersley Pool and Heath; Coleshill Pool; Hill Bickenhill; Marston Green; Honily; ponds near Earl's Wood; Forshaw Heath.

II. (*P. oblongus*) Foleshill; Arbury Park! *Kirk*, *Herb. Perry*; small pond near Drayton Bushes; pond in Banner's Lane, Tile Hill; pond near Oakley Wood, Warwick; pond in All Oaks Wood, Cathiron Lane, Brinklow.

P. rufescens, *Schrad.* *Reddish Pondweed.*

Native: In pools and ponds. Rather rare. July, August.

I. Annesley coalfield heath; *Bloxam*, *Phyt.* iii., 324. Olton Pool, abundant, 1881.

II. Whitmore Park, (near Coventry,) *Kirk*, *Herb. Brit. Mus.*; stagnant water in Arbury Deer Park, *Kirk*, *Phyt.* ii., 971; Alveston Heath, *Cheshire*, *Herb. Perry*. Canal, Stoke Heath, *Kirk*, *Herb. Perry*. Near Rugby, *H. W. T.*, *R. S. R.*, 1875. Cattle pond, Rounsel Lane, Kenilworth! *H. B.*; pond near Coventry, on the Allesley side; pond in Banner's Lane, Tile Hill.

P. lucens, *Linn.* *Great Pondweed.*

Native: In rivers, pools, and canals. Locally common. June to August.

I. River at Tamworth! *With.* (ed. 3) 173. Reservoir, Oldbury, near Atherstone; River Cole, Coleshill; canal, near Knowle; Earl's Wood Reservoir.

II. River Avon and ponds about Bidford! *Purt.*, i., 105; in an old canal, Arbury deer park; in the Oxford Canal, Stoke Heath! Myton; Chesterton! *Y. and B.*; canals near Little Lawford! and near Harborough! *R. S. R.*, 1877. Seas Pool, Arbury Park; old canal, Sowe Waste, abundantly in fruit; canal near Newbold-on-Avon.

b. decipiens, Nolte. Very rare.
Canal, Warwick, Sept., 1882, *R. L. Baker*. "Dr. Baker's plant approaches my var. *affinis* very closely, the only difference being that the spikes are longer than in Mr. Brotherston's Tweed plant." *A. Bennett, Bot. Ex. Club Rep.*, 1882, p. 78. I have only seen a very imperfect specimen of this plant from Warwick.

P. perfoliatus, *Linn.* *Perfoliate Pondweed.*
Native: In rivers, streams, pools, and canals. Locally common. June to August.
I. Oldbury Reservoir; Coleshill Pool; River Cole, near Coleshill; River Blythe, near Barston; Olton Reservoir; canal near Solihull, &c.
II. In the Stour below Honington, *Newb.*; Avon, near Bidford; Bearley Canal; Rowington Canal; Sowe Waste and Stoke Canals; pool in Combe Abbey grounds; old canals near Newbold-on-Avon.

R. crispus, *Linn.* *Curled Pondweed.*
Native: In streams and canals. Local. July to August.
I. Streams in Sutton Park; Oldbury Reservoir; Spring Pool, near Kinwalsey; stream near Blythe Bridge, Solihull; stream near Earlswood Reservoir.
II. Barnes Green, near Coventry, *T. K., Herb. Brit. Mus.*; old canal, between Newbold and Little Harborough! *R. S. R.*. 1877. Radway, Edge Hill; canal near Stratford-on-Avon, abundant; stream near Bearley; Ipsley; stream at Kingswood; pool in Combe Abbey grounds; stream by Worsley Bridge, Stoneleigh.

P. densus, *Linn.* *Opposite-leaved Pondweed.*
Native: In ponds. Rare. July, August.
II. In ponds and ditches on each side the road between Red Hill and Stratford-upon-Avon! *Purt.*, i., 106, abundant in flower in 1881. Moreton Morrel. *H. B.*, a very small-leaved form; abundant in pond, Bardon Hill; small pool, Green Lanes, Wilmcote; narrow-leaved form, canal near Wilmcote; in abundant flower, cattle pond, between Southam and Napton-on-the-Hill.

P. zosterifolius, *Schum.*
Native: In canals. Local. July, August.
I. Canal, near Atherstone, 1881. Canal near Hockley.
II. Abundant in the Oxford Canal, near Newbold-on-Avon! *Blox. N. B. G.*; canal near Rugby! *A. Blox., Herb. Brit. Mus.*; canal, Stoke Heath! 1855, *T. K., Herb. Brit. Mus.*; Warwick Canal, near Warwick and Hatton, *H. B.*! canal near Bearley, and Stratford-on-Avon; canal, near Holywell and Rowington; Napton-on-the-Hill; Sowe Waste Canal, abundant; &c.

P. obtusifolius, *M. and K.* *Obtuse-leaved Pondweed.*
Native: In canals and pools. Very rare. July, August.
II. Pit at Kenilworth, *H. B., Herb. Brit. Mus.*; canal near Stratford-on-Avon; Stoke Heath and Sowe Waste Canals; cattle pool, Banner's Lane, Tile Hill, in fruit.

P. mucronatus, *Schrad.*
Native: In canals. Very rare. July, August.
II. Canal, near Warwick, *H. B.*; canal, near Bearley and Wilmcote; canal, Sowe Waste; canal, near Newbold-on-Avon; Napton-on-the-Hill Canal.

P. pusillus, *Linn* *Small Pondweed.*
Native: in canals and pools. Very rare. July. August.
I. About Tamworth, Warwickshire, *With.* (ed. 2), 176. Meercote Mill Pool; Oldbury Reservoir.
II. In the old canal, Brownsover! *R. S. R.*, 1878. Canal, Warwick and Emscote, *H. B.* Abundant in the canal near Bishopton and Wilmcote; also in the old canal near Rugby Wharf and Newbold-on-Avon.
A narrow-leaved form, approaching var. *tenuissimus*, with the type, in the Wilmcote Canal.

P. pectinatus, *Linn.* *Fennel-leaved Pondweed.*
Native: in pools and canals. Locally common. July, August.
I. Sutton Park, in Bracebridge Pool, 1880. All through the Tamworth Canal, from Tyburn; the Warwick Canal, from Olton; the Stratford Canal, from Shirley Heath.
II. Near the canal bridge, Saltisford! *Perry Fl.;* old and new canals, near Newbold-on-Avon! *R. S. R.*, 1877; near Hatton, Holywell, Bearley, and Stratford-on-Avon; Birdingbury. Very abundant in the pool in Combe Abbey grounds.
A form closely approaching the var. *b. scoparius* Mr. Bromwich finds near Warwick and I find near Stratford-on-Avon. I believe it is an intermediate form.
Var. *c. flabellatus.* Very local; rare in flower.
I. Stratford Canal, near Hockley and Shirley Heath; Warwick Canal, near Solihull; canal near Atherstone.
II. Longford, Stoke Heath! *Herb. Perry*, *T. K.;* near Warwick! and Hatton, *H. B.* Tredington; Halford, *Newb.* Rowington Canal, canal near Bearley, Bishopton, and Stratford-on-Avon; canal, near Tardebigg; canal, near Sowe Waste; canal, Radford Semele; Birdingbury Wharf.

ZANNICHELLIA.

Z. palustris, *Linn.* *Common Horned Pondweed.*
Native: In rivers, ditches, pools, and canals. Local. June to August.
I. Ditches, Water Orton; River Cole, near Chelmsley Wood; drains on Coleshill Heath; spring pool, Kinwalsey; Marston Green; River Blythe, Stonebridge; Honily.
II. Kinwarton; Oversley, *Purt.* ii, 434; brook at the Woodloes, *H. B.*, *Exch. Club Rep.*, 1875; Compton Verney, *H. B.;* Honington, *Newb.* Alveston Heath; canal, near Stratford-on-Avon; Stratford Canal, near Kingswood; stream, Worsley Bridge, Stoneleigh; old canal, near Newbold-on-Avon; small pool, near Willoughby, Rugby.
The plants at Water Orton and the brook at the Woodloes belong to a form intermediate between *palustris* and *pedicillata*, discussed in the Exchange Club Report, 1875, pages 28-29. The variety *brachystemon*, Gay, is the most common form in this county.

ALISMACEÆ.

TRIGLOCHIN.

T. palustre, *Linn.* *Marsh Arrowgrass.*
Native: In marshes, damp meadows, and near pools, &c. Local. June to August.

I. Near Tamworth, *With.* (ed. 7), 460; Sutton! *Freeman, Phyt.* i, 292; bogs, Coleshill! *Bree, Mag. Nat. Hist.*, iii, 164; Sutton Park; wet meadows, near Maney; Olton Pool; Packington.

II. Above the village of Great Alne, *Purt.*, i., 188, Myton; Haseley, *Y. and B.;* canal bank, Napton, *Bolton King;* canal bank, Holywell; near Claverdon; canal bank, Sowe Waste; Henley Mill, Wyken.

SAGITTARIA.

S. sagittifolia, *Linn.* *Common Arrowhead.*

Native: In rivers, pools, and canals. Local. July, August.

I. Pools near Castle Bromwich railway station; Warwick Canal, near Olton, Solihull, Knowle; canal, near Curdworth; canal, near Atherstone; near Polesworth; canal, near Shirley Heath; near the locks, Temple Balsall.

II. On the banks of the Avon, at Stratford! and in ditches about Bidford! *Purt.* i, 188; Nicholas Meadows, *Perry*, 1817. In the River Leam, Leamington, *Perry, Fl.;* Stoke Heath! *T. K., Herb. Brit. Mus.;* common in the Avon and canal near Rugby! *Blox., N. B. G. S.;* in the Stour, below Tredington, *Newb.;* Chadshunt (introduced), *Bolton King;* canal, from Rowington to Stratford-on-Avon; Warwick Canal, Rowington; Birdingbury Canal; in the Sowe, near Binley; Sowe Waste and Ansty Canals; canal, Long Itchington; Birdingbury Canal; Willoughby.

ALISMA.

A. plantago, *Linn.* *Greater Water Plantain.*

Native: In rivers, pools, canals, and ditches. Common. July to September. Area general.

b. lanceolata. Rare.

I. Canal, near Catherine de Barnes Heath, 1883; canal, Shirley Heath.

II. Honington, by the bridge on the way to Iddicote, *Newb.;* canal, near Myton! *H.B.* Small pool in brickyard, near Gaydon; Alveston pastures, in marshy drives; canal, near Tardebigg; canal, near Wilmcote.

A. ranunculoides, *Linn.* *Lesser Water Plantain.*

Native: In marshy pools. Very rare. July.

I. Tamworth; *Herb. Perry.*

II. Wimpstone fields, near Alderminster, *Cheshire, Herb. Perry.*

BUTOMUS.

B. umbellatus, *Linn.* *Flowering Rush.*

Native: Near rivers, ponds, pools, and canals. Locally abundant. June to August.

I. Blythe Heath, near Solihull! 1836, *Rev. J. Gorle.* Blythe! and Cole! *Bree, Purt.* iii., 357. Canal, near Atherstone; pit, near Stechford; Warwick Canal, near Solihull and Knowle; Tythall Lane, Solihull; cattle pond, Balsall Street; canal, Shirley Heath.

II. Oversley Bridge! Great Alne Mill, *Purt.* i, 203; Priory Pool and in the River Avon! Warwick, *Perry Fl.;* Radford, *Y. and B.* Salford Priors! *Rev. J. C.;* canal, Leamington and Longford, *Perry Fl.;* river and canal, near Newbold-on-Avon! *R.S.R.;* Willoughby, near Rugby; Birdingbury Canal; Napton Canal, near Long Itchington; canal, Sowe Waste and Ansty; canal, near Wilmcote and Bearley; canal and pool, near Yarningale Common.

HYDROCHARIDACEÆ.

ELODEA.

E. canadensis, *Linn.* *Water Thyme.*
Alien: In rivers, canals, pools, ponds, and ditches. Common, but rather rare in flower. July, August.
I. Sutton Park; Coleshill Pool; canal, Shirley Heath.
II. Canal, Preston Bagot; pond by Tile Hill Wood; pit in an old quarry near Little Lawford; canal, Sowe Waste; canal, near Newbold-on-Avon; canal, near Birdingbury Wharf; Napton Canal, near Radford Semele; pool at Willoughby, near Rugby.
In all the above stations in abundant flower.

ORCHIDACEÆ.

ORCHIS.

O. pyramidalis, *Linn,* *Pyramidal Orchis.*
Native: In marly and calcareous pastures and in woods and copses. Rare. June, July.
II. Ragley Park, Grafton, *Purt.* ii., 422. Pillerton, *Perry*, 1817. Whitnash; Drayton bushes! *W. C.*, *Herb. Perry.* Canal bank, near Newbold Tunnel, single specimen, *R. S. R.*, 1877. Morton Morrel, *Y. and B.* Compton Verney, *Bolton King.* Pastures, bridle road, Wilmcote to Billesley; Drayton Rough moors.

O. Morio, *Linn.* *Green-winged Meadow Orchis.*
Native: In meadows and pastures. Local. May, June.
I. Coleshill Heath; Curdworth; meadows near Hurley and Nether Whitacre; fields about Solihull, Packwood, &c.
II. Honington, Tredington, Shipston-on-Stour, *Newb.;* near Rainsbrook, *R.S.R.*, 1877. Lodge Woods, Salford, *Rev. J. C.*, Moreton Morrel, Aston Cantlow; Kingswood; Honily, &c.

O. mascula, *Linn.* *Early Purple Orchis.*
Native: On banks and in copses and woods. Local. May, June.
I. Small Heath, in pastures; coppice, near Bedlam's End; Nether Whitacre; near Moor Hall, Sutton.
II. Chesterton! *Y. and B.;* Honington, *Newb.;* Friz Wood, Compton Verney; Alveston Pastures; Oversley Wood; Red Hill; Drayton Bushes; Combe Woods; spinney in Cathiron Lane, near Rugby; Seas Wood, Arbury.

O. incarnata, *Linn.* *Common Marsh Orchis.*
Native: In marshes. Very rare. July.
I. Marshy field, near Olton Pool; marsh, near Stonebridge.
II. Boggy ground, near Halford, *Newb.;* Binton Bridges.

O. latifolia, *Linn.* *Broad-leaved Marsh Orchis.*
Native: In marshes and marshy meadows. June, July.
I. Bogs, Coleshill! *Bree, Mag. Nat. Hist.*, iii., 164; Hill Bickenhill; Sutton Park.
II. Near Baly's Locks, *Perry*, 1817. Warwick, *Herb. Perry;* Tachbrook, *Y. and B.;* meadow near Brown's Over, *R. S. R.*, 1877; near Honington and Halford, *Newb.;* Chadshunt, *Bolton King.*

O. maculata, *Linn.* *Spotted Palmate Orchis.*
Native: In bogs, wet pastures, and woods. Locally common. May, July.

I. Sutton Park; Middleton Heath; Kingsbury Wood; Baddesley Ensor; Hartshill Hayes; Bentley Park; Coleshill Heath; Hampton-in-Arden; lanes about Knowle and Solihull; Earl's Wood; Forshaw Heath; &c.

II. Rowington, *Y. and B.*; Compton Wynyates, *Rev. J. Gorle*; Honington, Tredington, *Newb.*; Alveston Pastures; Oversley Wood; Arrow Lane; Clark's Green and Out Hills, near Studley; Moreton Bagot, Shuckburgh; Willoughby, near Rugby, &c.

GYMNADENIA.

G. conopsea, *Brown.* *Fragrant Orchis.*

Native: On damp marly banks and in old pastures. Rare. July.

I. Chelmsley Wood, Coleshill; Bannersley Pool, *Bree.*, *Mag. Nat. Hist.*, iii, 164. I have not been able to find it in either of these localities.

II. Cold Comfort; Oversley! *Purt.* ii, 423. Footway to Billesley, *W. C.* Whitnash Fields, *Herb. Perry.* Plentiful in meadows at Ipsley! *Slatter.* Canal bank, near Rowington.

HABENARIA.

H. viridis, *Brown.* *Frog Orchis.*

Native: In old pastures. Rare. June, July.

II. Meadows about Cold Comfort; Oversley Hill, *Purt.*, ii, 421. Rounsel Lane, Kenilworth; near Stratford-on-Avon, *W. C.*; Honily, *Herb. Perry.* Old pastures, Ipsley! *Slatter.* Hampton-on-the-Hill, *H. B.*

H. bifolia, *Bab. Man.* *Lesser Butterfly Orchis.*

Native: In old pastures. Very rare. July.

II. Large field on the Comyns Farm, between the houses and Clopton, *W. C.*, *Herb. Perry.*

H. chlorantha, *Bab.* *Greater Butterfly Orchis.*

Native: In damp woods and copses. Very local. June, July.

I. Asbury's Coppice, Hampton-in-Arden, *Rogers.* Kingsbury Wood; Coppice, near Blossom Fields, Solihull; Shelly Coppice; Coppice, near Bedlam's End.

II. Near Wellesbourn, *W. C.*, *Herb. Perry.* Old Park; Harbury; Chesterton Wood! *H. B.* Lodge Woods, Salford Priors, *Rev. J. C.* Canal bank, near Clifton, *R. S. R.*, 1877. Chadshunt, *Bolton King.* Compton Verney; Alveston Pastures; Drayton Bushes; Red Hill.

OPHRYS.

O. apifera, *Huds.* *Bee Orchis.*

Native: On banks in lias and marly soils. Rare. July.

II. Canal cutting, Rowington, *H. B.*, *Herb. Perry.* Near Rowington, *Miss Betts.* Near Birdingbury Wharf; Compton Verney, *H. B.* Hampton-on-the-Hill, *Pratt.* Old Lime Pits, Newbold; Canal bank, near Newbold Tunnel, *R. S. R.*, 1878. Canal bank, near Clifton, *L. Cummin.* Piper's Bolt, Lighthorne, *Bolton King.* Railway bank, near Harbury Station; Canal bank, near Bearley.

(To be continued.)

METEOROLOGICAL NOTES.—July, 1884.

The barometer was generally unsteady throughout the month; falling gradually from 30·179 inches on the 2nd, to 29·634 inches on the 10th. Thence it fluctuated considerably, rising to 30·194 inches at the end of the month; the weather was, consequently, very unsettled. Temperature was high on some of the earlier days, the following maxima being recorded:—85°·7 at Loughborough, 84°·4 at Hodsock, 82°·0 at Henley-in-Arden, and 80°·6 at Coston Rectory. On the 4th the heat of the rays of the sun (black bulb *in vacuo*) reached 136°·3 at Hodsock and 136°·0 at Loughborough; on some of the following days the maxima were low. The night temperatures were uniformly rather high, the lowest registered being 40°·0 at Coston Rectory, 40°·7 at Hodsock, 41°·0 at Henley-in-Arden, and 45°·0 at Loughborough. July was decidedly a wet month, and the rainfall was in excess of the average. The total values were:—Coston Rectory, 4·92 inches; Hodsock, 4·20 inches; Henley-in-Arden, 3·22 inches; Loughborough, 2·94 inches. The number of "rainy days" varied from 19 to 22. Mr. Mellish, of Hodsock Priory, near Worksop, writes:—"This (2·04 inches, on the 9th) is the heaviest fall yet recorded here in 24 hours; of the total, 1·34 inches fell in 1 hour 20 mins., and as there were several 'lulls,' the greater part fell in a much shorter time." Sunshine was deficient. The wind was chiefly from the south-westward, and varied much in force. Severe thunderstorms visited the Midland Counties at the commencement of the month, and caused loss of life and much damage to live stock and property.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street, Loughborough, 20th August, 1884.

Natural History Notes.

A Correction.—The specimens of the Chain Brand, *Xenodochus carbonarius*, mentioned in the last report of the Birmingham Microscopists' and Naturalists' Union as occurring on *Poterium Sanguisorba*, were on *Sanguisorba officinalis*.

Alternaria Brassicæ, Saccardo.—This curious little fungus has just occurred to me on the half-dead leaves of *Cytisus Laburnum*, which were killed by what I take to be *Phyllosticta cytisella*, Sacc. On the arid spots produced by this latter fungus, a lens revealed a number of minute forms, of which the following is a description:—Hyphæ very short, scattered or gregarious, erect, pale brown, 25 – 30μ x 5μ. Spores apical, erect, single or shortly concatenate, lageniform, *i.e.*, ovate with a prolonged beak, clear olive brown, multiseptate and muriform, somewhat constricted, $90-110\mu \times 20-26\mu$. It will be observed that the fungus is very similar to *Macrosporium Brassicæ*, Berk., but if it is identical, as Saccardo asserts, then the descriptions and figures of the latter species must represent the spores as attached by the *wrong* end. The spores of the Alternaria were mostly single, or occasionally two or three in a short chain. I shall be glad to know the truth of the matter.—W. B. GROVE, B.A.

FORMATION OF STARCH.—Professor Sachs has been engaged in the study of the rate of formation and disappearance of starch in the leaves of growing plants, and as the process for conducting these researches, unlike those for determining the amount of absorption of water by the living plant, is easy to carry out, and requires little or no apparatus, I think I may venture to describe it more in detail, as, perhaps, some present, especially those who reside in country districts, might be inclined to assist in this research by their own observations. The leaf to be examined is first plunged into boiling water for about ten minutes, then taken out and digested in alcohol for about the same time (I find methylated spirit answers perfectly well). This treatment extracts the whole of the colouring matter (chlorophyll) and leaves the leaf perfectly white. The leaf is now placed in an alcoholic solution of iodine, and the presence or absence of starch is demonstrated in a few minutes. The absorption of iodine commences at the edges, and soon colours the leaf blue-black if much starch be present, or brown if the quantity of starch be but small. The venation of the leaf appears as a pale network upon a dark ground, rendering it a very beautiful object; but all my efforts to preserve the specimen beyond a few hours have hitherto failed. The curious and interesting information obtained from these researches is, that the amount of starch present in the leaf of any given plant varies considerably under different circumstances. In direct sunshine, and under otherwise favourable circumstances, starch is formed very rapidly; but it generally disappears entirely during the night, so that a leaf collected in the evening will prove full of starch, while another leaf of the same plant collected before sunrise will not show a trace. It is also an interesting fact, but one we should quite anticipate, that if the air surrounding the plant is deprived of its carbonic acid by means of caustic soda, no production of starch takes place, even in direct sunshine, and with warmth and moisture that would under other conditions be sufficient. Again, the gradual increase in the quantity of starch produced during the day, and under specified conditions, is a matter of great interest, as it would point to certain times and conditions when the plant would probably be more vigorous, and the activity of its medicinal principles greater than at some other time. We already recognise the importance of plants intended for medicinal use being collected at certain periods of growth, but it is possible that we have still something to learn upon this subject.—From the *Pharmaceutical Journal.*

ENGLISH-GROWN MEDICINAL RHUBARB.—At the recent meeting of the British Pharmaceutical Conference, as reported in the *Pharmaceutical Journal*, Mr. W. Elborne read a paper on the cultivation of medicinal Rhubarb. It would appear that English-grown "Rhubarb," from *Rheum officinale*, the plant which was first brought to Europe about sixteen years ago (*Pharm. Journ.* [3], iii., 301), has now taken its place side by side in commerce with that from *R. rhaponticum*, from which it may be distinguished upon fracture by the comparatively black colour of the veins imbedded in a white parenchymatous tissue.

The excessive development of this tissue, observed in the earlier experimental samples of this variety by Mr. Holmes (*Pharm. Journ.* [3], vii., 301), was no doubt due to "high cultivation," and it has been found that with a slower growth the roots become more dense, and when prepared are of a richer and darker colour. One of the reports was devoted to some historical, botanical, and microscopical notes on English-grown Rhubarb, and the methods of its preparation, and the other gave the results of a series of analyses showing to a certain extent the constituents of samples of English "officinale" and "rhaponticum," East Indian and the old-fashioned Russian Rhubarbs. It was mentioned that the production of English rhubarb now amounts to twelve thousand pounds weight yearly.

Equinoctial Gales.—According to Mr. R. H. Scott, the occurrence, as a regular thing, of violent storms about the time of the equinoxes is as much a myth as the alleged influence of the moon on the weather. Statistical records show that gales are of no greater frequency at the equinoxes than at any other time, but are all but exclusively confined to the winter half year.

"Correspondance Botanique."—Prof. E. Morren has published the tenth edition of his Directory of Botanists, scientific and horticultural establishments throughout the world. This list, which is indispensable to all who have relations with foreign botanic gardens and museums, is published by the compiler at 1, La Boverie, Liège, Belgium.

Diseases of Field and Garden Crops.—We are pleased to be able to announce the publication of a small volume on this subject from the pen of Mr. Worthington Smith, to which we shall have further occasion to refer. It is published by Macmillan.

Midland Union of Natural History Societies.—Peterborough Meeting.—It may interest the members of the various Societies in the Union to know that the receipts and expenditure in connection with the recent Annual Meeting nearly balanced the accounts, showing a deficit of 14s. 5d. only, which result, considering there were other attractions in the town on the day the conversazione was held, the local committee consider very satisfactory.—Edwin Wheeler.

Dimensions of a few Rare Conifers.—A correspondent kindly sends us the following about some trees at Penny Hill, Bagshot, a locality very favourable to the growth of Coniferous plants:—*Sciadopitys verticillata*, 15ft. high, 13½ft. in diameter of head; *Thuiopsis Standishii*, 19½ft. high, 11ft. through the head; *Thuiopsis dolabrata*, 17ft. high, 10ft. through the head; *Juniperus japonica alba*, 13½ft. high, and 11ft. in diameter of head. These handsome specimens stand in the grounds of Louis Schott, Esq.—*Gardener's Chronicle.*

Mr. Austin Dobson's "Thomas Bewick and his Pupils," based upon his articles in the *Century Magazine*, will be published in September by Messrs. Chatto and Windus and Messrs. J. R. Osgood and Co., of New York. The whole of the large paper copies are already disposed of. The "Memorial Edition" of Bewick, the publication of which was delayed by the death of Mr. Ward, of Newcastle, will now be published by Mr. Quaritch for Mr. Ward's sons, the present owners of the blocks. It will consist of five volumes—the "Birds" (two), "Quadrupeds," "Fables of Æsop," and "Memoir." The "Memoir" will be edited from the original MS. by Mr. Dobson, who will also annotate it with the aid of Bewick's letters and papers, which have recently been placed in his hands by the late Miss Isabella Bewick's executors. The first volume of the new edition may be expected in 1885.—*Athenæum.*

Sir Richard Owen's "History of British Fossil Reptiles," which has been upwards of forty years in preparation, is now at length ready for publication by Messrs. Cassell. On the preparation of the 268 plates with which the volumes are enriched great labour and attention have been lavished. The edition consists of 170 copies only (each copy being signed by Prof. Owen), and no further number can be produced, as the plates from which the illustrations have been printed have been destroyed. The publishers are anxious to give an opportunity to the chief libraries of the kingdom of acquiring the work. Among the original subscribers were many distinguished men who are now dead, such as the Prince Consort, the Duke of Buccleuch, the Earl of Derby (the grandfather of the present earl), Sir P. de Malpas Egerton, Sir J. J. Guest (the father of Lord Wimborne), Henry Hallam, Sir Robert Inglis, Sir William Jardine, Prof. Lindley, Sir Roderick Murchison, Bishop Wilberforce, Chief Baron Pollock, Prof. Sedgwick, Dr. Whewell, Sir F. Thesiger, and Lord Wrottesley.—*Athenæum.*

Henry Bohn.—The death, in his 89th year, of Mr. Henry Bohn is announced. He will be longest remembered as a publisher, to whose insight and energy students of almost all departments of literature and science owe a deep debt of gratitude. He was the means of placing within their reach scores and hundreds of volumes, to which otherwise they could have had no ready access, if access at all. Mr. Bohn was a Fellow of the Royal Horticultural Society in its palmy days, and at one time took great and active interest in its proceedings, and he was to the last a valued supporter of the Gardeners' Royal Benevolent Institution. Warm-hearted and impulsive, his feelings were generous and sympathetic. A man of taste and wide knowledge, his appreciation was keen and singularly varied. As a horticulturist his garden at Twickenham was chiefly remarkable for the large collections of hardy deciduous shrubs and Conifers, got together to a large extent in consequence of his connection with the Royal Horticultural Society and his friendship with the late Mr. Gordon, to the second edition of whose "Pinetum" Mr. Bohn contributed a valuable appendix of popular names, and a series of references to coloured plates.—*Gardener's Chronicle.*

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, held July 29th.—Mr. J. Morley exhibited, on behalf of Mr. W. R. Hughes, a number of plants from near Reading, Berkshire, including the following:—*Cuscuta Epithymum*, *Genista anglica*, *Lythrum Salicaria*, *Agrimonia Eupatoria*, and *Hordeum pratense*. Mr. W. B. Grove, B.A., exhibited *Puccinia Baryi* (new to Warwickshire in the perfect stage), *Ramularia Lapsanæ*, and *Sporodesmium lobatum* (new to the district); and on behalf of Mrs. Rabone, *Puccinia Buxi*, *Ræstelia cornuta* (in the spermogone stage), from Windermere. Mr. T. Bolton exhibited *Cordylophora lacustris*, living and mounted specimens. Mr. C. R. Robinson exhibited a Dahlia with two flower heads on one stem. Biological Section, August 12th.—Mr. W. H. Wilkinson gave an account of the excursion to Bradnock's Marsh, and exhibited from that district *Campanula latifolia*, *C. patula*, *C. hybrida*, *Plantago media*, *Geranium phæum*, and other rare plants. Mr. T. Bolton *Holopedium gibberum*, an entomostracan from Grasmere. Mr. J. E. Bagnall, *Sison Amomum* (new to North Warwick), *Sium angustifolium*, *Alisma lanceolata*, *Spargania simplex*, and other plants from near Shirley; for Mr. A. W. Wills, *Didymium farinaceum*, a small fungus growing on the dead roots of orchidaceous plants; for Mr. W. Southall, *Vicia Cracca*, in which the leaves had been transformed into the semblance of racemes of fruiting pods, this appearance being due to insect agency; for Mr. J. Saunders, of Luton, *Drosera Anglica*, *D. intermedia*, *Malaxis paludosa*, *Carex limosa*, *Rhyncospora fusca*, and *Spiranthes æstivalis*, all from the New Forest; for Mr. W. Halden, *Anastatica Hierochuntia*, the beautiful Rose of Jericho, the remarkable hygroscopic properties of which were displayed; for Mr. R. M. Serjeantson, *Saracha umbellata*, one of the Solanaceæ, a native of Peru, which had sprung up spontaneously in the Rectory Garden, Acton Burnell. GENERAL MEETING, held August 19th.—Mr. W. B. Grove, B.A., exhibited *Fusidium viride*, *Ramularia urticæ*, *Peronospora viciæ*, *Ovularia sphæroidea*, *Coleosporium sonchi*, *Uromyces rumicis*, *Erineum alneum*, *Cladosporium epiphyllum*, from Hampton-in-Arden, and *Diaporthe Tessella* (new to Britain), from Borough Fen, Peterborough, collected during the excursion of the Midland Union. GEOLOGICAL SECTION, August 26th.—Mr. J. Edmonds exhibited, *(a)* adjustable lens, 6in. to 4in., *(b)* adjustable lens, 3in. to 2in., both by Wray of London; *(c)* Specimens of Sandstone, with a thin stratum of mica, showing ripple marks. Mr. Watson exhibited some beautiful Photographs from the Postal Photographical Society. Mr. W. B. Grove, *Arcyria nutans*, *Alternaria Brassicæ* (new to district). Mr. John Levick, *Zoothamnium arbuscula*.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 21st.—Mr. Insley exhibited a specimen of Bog Pimpernel, *Anagallis tenella*, with extra large flowers from the Isle of Man; Mr. J. Darley, a small collection of moths, including Clouded Buff, *Euthemonia russula*, and beautiful Yellow Underwing, *Anarta myrtilli*; Mr. Moore, a pair of Beetles, *Cychrus rostratus*, also gizzard of the same, under the microscope; Mr. Madison, specimens of Calc-tuff, from the Rushall Canal. Under the microscope, Mr. Foster exhibited a section of Collier's lung, showing a deposit of coal dust in the air cells; Mr. J. W. Neville, Trachea, taken from larva of Drinker moth. July 28th.—Mr. J. Betteridge exhibited a female specimen of Great-crested Grebe, *Podiceps cristatus*, in full summer plumage, shot at Westheath; Mr. Hawkes, a series of objects showing several stages in the life history of a Dragon-fly, *Cordulegaster annulatus*, Drinker Moth, and Great Water-beetle, *Dytiscus marginalis*; Mr. Delicate, a number of moths, from King's Heath. Under the microscope, Mr. J. W. Neville showed the alimentary canal, etc. of *Dytiscus marginalis*, showing its carnivorous habits. Mr. P. T. Deakin then read a paper, "Notes on the Nuthatch, *Sitta Europæa*," which gave a description of the genus, species, etc., pointing out that though this bird was rare in the north and unknown in Scotland, it was not uncommon with us, and could frequently be seen in Sutton Park and other neighbouring woodlands. Its nesting habits, food, and manner of feeding were described, and the paper concluded with a description of its treatment in captivity. The paper was illustrated with stuffed specimens, eggs, etc. August 11th.—Mr. Madison exhibited specimens of *Helix aspersa* var. *conoidea*, and var. *nigrescens*, from Weston-super-Mare; Mr. Delicate, a typical collection of shells from Great Grimsby; Mr. F. Shrive, living specimen of Blind-worm, also two Ringed-snakes, one from near Redditch, and the other from Cambridgeshire. Under the microscope, Mr. Hawkes showed a fish parasite, *Argulus foliaceus*; Mr. J. W. Neville, teeth of House-fly, *Musca domestica*.

Plate V

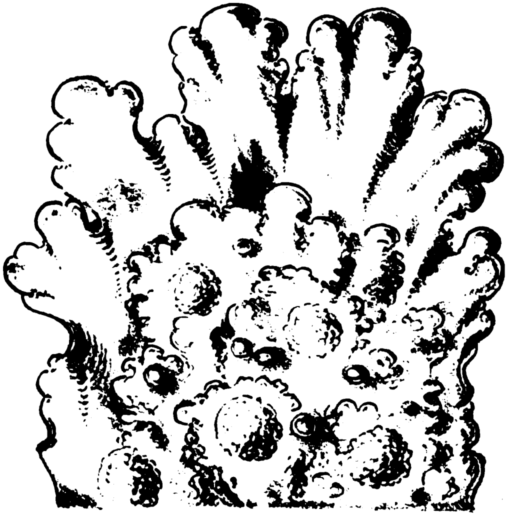

Fig 1

Fig 2.

Fig 3

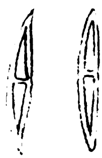

Fig 4.

Fig 5.

Fig 6.

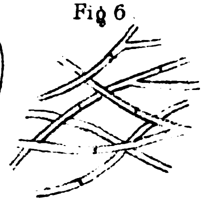

Fig 7

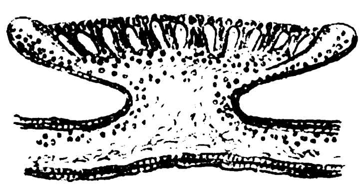

Fig 8.

Fig 9.

RICASOLIA AMPLISSIMA

W. H. W. Del. — H. B. G. Lith.

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THE STUDY OF A LICHEN FROM OBAN.

(*RICASOLIA AMPLISSIMA.**)

BY W. H. WILKINSON,
HONORARY SECRETARY OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

The rapid increase in commercial pressure and in mental activity during the last twenty years renders it most desirable to break away from the busy hum of town life and to seek rest and quiet and new mental and physical vigour by a visit to the country. Nor will such time be lost if wisely spent, for health will continue longer under the increasing strain if ever and anon eased of its pressure for a brief season.

In selecting a place to visit the sea side is to be chosen as offering at once the combined charms of land and water, the shore and the fields; and of all the lovely spots on earth perhaps few accessible to us surpass Oban. the scene of some of the most successful excursions of the Birmingham Natural History Society. Here Nature seems to reign undisturbed, and whatever be the taste of the visitor he may find abundant material for its gratification. The sea with its charming islands and the mysterious treasures of its mighty depths, the rising cliff and cloud-capped mountain, the forest and the valley, the gurgling stream and glassy lake—all offer their treasures of knowledge to the skilful student. In such a spot every object seems illumined by a glory all its own, beauty and peace seem enthroned, and the heart is irresistibly drawn to worship the unseen Creator and Sustainer of all. Nor do the larger forms of life absorb our whole attention, for we find "The Infinite equally in the minute as in the vast," and by the aid of the instruments which modern science has placed at our command we can for ourselves unfold some of the wonders of creation.

DESCRIPTION OF PLATE V.

Fig. 1.—*Ricasolia amplissima*, natural size.
Fig. 2.—Green gonidia.
Fig. 3.—Spores.
Fig. 4.—Paraphyses.
Fig. 5.—Asci, young and mature.
Fig. 6.—Medullary layer.
Fig. 7.—Section of glomerulus.
Fig. 8.—Mature apothecium.
Fig. 9.—Section of thallus.

All the drawings are magnified, except Fig. 1.

* Transactions of the Birmingham Natural History and Microscopical Society. Read April 8th, 1884.

As a sample we may take the Lichen which forms the subject of this paper, as it is one of a family of plants often overlooked, sometimes even despised; yet how amply will these plants repay a little careful study—

> "That not alone in trees and flowers
> The spirit bright of beauty dwells;
> That not alone in lofty bowers
> The mighty hand of God is seen;
> But more triumphant still in things men count as mean."

Nor do the poets alone value the lowly lichen, but the artist, too, has learned to value those humble plants, which impart their rich velvety tints and give such soft beauty to the rocks and trees in his landscapes. But to the scientific botanist the Lichens form a link without which the chain of Nature would not be complete. Their constitution still forms a battle-ground for our most advanced cryptogamists, while much interest is aroused by the age to which the Lichens are supposed to attain, and their capabilities of enduring great extremes of climate, some species flourishing in the tropics and others in the temperate zone, while some attain their utmost luxuriance even amidst the snows of the frigid zone itself.

It is certain that provision is made in some kinds of Lichens to endure great changes of the surrounding elements, to resist alike the withering effect of continued drought and the more fatal influence of excessive moisture—qualities which must tend to a long continuance of existence. Certainly more information could be collected on these points, and a more careful study of the Lichens in these different conditions would soon shed a clearer light upon their life history.

The particular species of Lichen to which we wish now to confine our attention is called *Ricasolia amplissima*, and is usually found growing upon trees in shady situations, and from one of the charming woods near Oban our specimen was gathered (Fig. 1).

The thallus, or leaf-like expansion, consists of several very distinct parts, as you will see by reference to the drawing (Fig. 9); *c* represents the cortical layer, which is composed of layers of dense cells somewhat flattened by pressure, and although so much thickened in their cell walls still retaining sufficient transparency (especially when moist) to allow the bright green hue of the gonidia to be seen through them.

We next come to the gonidial stratum marked *g* in the drawing, which consists of a vast number of spherical cells, each containing green granular matter. These cells seem to be free and to have but little connection with the other parts of the plant. Yet they perform a very important part in perpetuating the species by bursting through the cortical layer in various ways, and under favourable conditions developing into a new plant like the parent. So different does this gonidial layer seem from the other parts of the plant that Schwendener and some other botanists have ventured to suggest that the gonidia may be a mass of separate plants making the Lichen their home, thus forming a "dual life," but however fascinating this theory may be it requires a clearer elucidation of the facts of the life history of the lichen to support it.

The medullary layer is marked *m* in Fig. 9, and is seen magnified in Fig. 6; it consists of a mass of threads which on examination will be found to be tubes divided by septa; most probably elongated cells joined end to end. By these moisture is rapidly absorbed and doubtless retained for the future use of the plant, yet they do not seem to exhibit any ordinary kind of circulation.

Below this is the subcortical layer *sc*, similar to the upper layer but not so dense, and from it bundles of filaments proceed called rhizinæ *r*, which serve to attach the plant firmly to the bark of the tree, but here their work ends, as they do not perform the part of true roots in supplying nutriment.

The apothecium is one of those cup-shaped discs which lie scattered over the central portion of the thallus in Fig. 1, and a section of which is given at *d* in Fig. 9. The outer portion of the apothecium is formed of the thallus, and is really a continuation of its various layers, including the green gonidial layer.

The central portion, the hymenium or disc, is formed of paraphyses and asci; the paraphyses (Fig. 4) are slender filaments enlarged and coloured at their ends, the mass of which packed closely together gives the red colour to the hymenium.

The asci are transparent sacs which, when mature, are club shaped, and contain the spores—usually eight, placed in a spiral manner in the ascus—but when young are slender and filled with protoplasm (Fig. 5).

The spores (Fig. 8) are long, and taper at the ends, with a division in the middle separating them each into two cells. When the spores are fully ripe they are expelled from the summit of the ascus by the pressure caused by the swelling of the paraphyses and asci by the absorption of moisture, and probably by a simultaneous contraction of the lower portion of the apothecium, causing the ascus to be ruptured and the spores to be forced up to the surface of the disc. A remarkable feature of the apothecium is that it produces a succession of asci, so that young ones are growing up to take the places of the old ones.

The spermogones, a section of one of which is seen at *s* (Fig. 9), are flask-shaped receptacles formed in the medullary layer, but forcing for themselves a passage through the upper layers to the surface of the thallus and there opening by a minute pore. These receptacles contain a vast number of sterigmata, which give rise to the spermatia; the latter are easily detached by a slight pressure and rise through the pore to the surface. These spermatia are supposed by some to be used in the fertilisation of the plant, somewhat similar to the pollen grains in flowering plants, but this has never been proved to be the case.

There is one other point to which we wish to draw attention; it is the soredia, consisting of a granular powder which appears on the surface of the thallus, and is presumed to be the outgrowth of the gonidial layer. In some Lichens it forms oval patches scattered over the surface—as in *Ramalina;* in others it is developed on the edges, forming a border, as in *Sticta scrobiculata;* while in others it covers the whole surface—as in *Pertusaria;* and again, in other kinds it forms a coral-like *(isidiose)* appearance—as in *Parmelia Saxatilis*, var. *furfuracea.*

In the specimen before us it does not assume any of these forms, but causes an abnormal growth of the thallus, which under the microscope looks like the rugged trunk and branches of an oak-tree, covered with an olive-green powder. And these clusters of branches *(glomeruli)* gave the old name to the plant *Parmelia glomerulifera.* They will be seen in Fig. 1, and in section in Fig. 9.

The use of the soredia is generally supposed to be to perpetuate the plant when its surrounding conditions are unfavourable for the formation of spores. As for instance, *Parmelia physodes*, which grows so abundantly on the Lickey Hills, and yet has never been found in fruit there: the plant may yet be found abundantly in every size, from some inches in diameter down to the germ just beginning life on its own account. Now this plant must depend upon the soredia only for its abundant and successful growth there in the general struggle for existence.

From our study of this "Lichen from Oban" we may fairly conclude that loveliness and beauty are to be found in these lower forms of plant life as much as in those more highly developed; and we cannot fail to admire the wisdom displayed in the wonderful provision for the growth and reproduction of this plant:—

In the thallus by its power to endure the extremes of climatic changes of heat and cold, of drought and moisture, without injury. In the power of the apothecium to produce a succession of new asci and spores instead of perishing after the first batch of spores was mature, as a flower would fade and die ere its seeds were fully formed and ripened. And, lastly, in the provision which the soredia make for the perpetuation of the plant when circumstances are unfavourable for the formation of spores. So here, in the lowly Lichen, as wherever else we approach it, Nature seems to say—"The hand that made us is divine."

If any of our friends would wish to study more of the British Lichens, I would refer them to the works of the Rev. W. A. Leighton, B.A., W. L. Lindsay, M.D., or to the excellent papers by Mr. W. Phillips, F.L.S., in the "Midland Naturalist" for 1880.

LUNULARIA VULGARIS, MICH. *

BY REVD. H. P. READER, M.A.

The Hepatica on which I intend to make a few remarks seems to be an addition to our county list; at the same time I can hardly feel that in this case I am recording a novelty so much as calling attention to a plant which is familiar to many of us, but has not so far been discriminated.

Lunularia vulgaris, Mich. belongs to the Schizocarpous section of the order Marchantiaceæ. It is in fact the *Marchantia cruciata* of Linnæus, and is so called by most of the older botanists, with the exception of Gray, who prefers to term it *Staurophora pulchella*.

Lunularia, however, differs structurally from Marchantia and its nearest allies in no slight degree. The differences are principally in the fructification, which is rarely found, and thus an imperfect knowledge of the plant may perhaps have caused it to be referred to a genus to which it certainly does not belong. What these differences are I shall explain in the course of this paper.

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read March 19th, 1884.

I take *Lunularia vulgaris* to be a widely distributed and common Hepatica in Great Britain. At the same time it appears to be exclusively confined to cultivated ground, and is, probably, in its origin an introduction. The same, however, may be said of many well-known cornfield weeds, which have long ago taken their place in the British Flora.

Its favourite habitats are damp shady paths in gardens, neglected flower beds, crevices in old walls,—and it is often exceedingly abundant in greenhouses. I have seen it asserted that *Asterella* (Marchantia) *hemisphærica* is a pest to gardeners in this respect; but the plant intended is doubtless the one we are considering.

In such situations, then, I have found Lunularia to be more or less plentiful throughout England; and Leicestershire seems to produce it as abundantly as any other county known to me. Amongst county localities for it I may mention Birstall, Husband's Bosworth, and the grounds of the Cistercian Abbey, near Coalville. In the London Catalogue of British Mosses and Hepatics (ed. 1881) it is recorded from eleven out of the twenty-one provinces into which Watson has divided Great Britain, and also from Ireland.

In calling Lunularia a common plant, I must be understood to refer only to an imperfect state of it. Both the male receptacles and the fructification seem to be extremely rare. Indeed, the "Synopsis Hepaticarum" says that it rarely perfects its fruit even in Southern Europe, whilst in the central and northern parts, where it is "per hortos cultura jam divulgata," the plant is always barren.

This, however, is not precisely the case, since I possess well developed fruit from Minehead in Somerset, and I have seen other examples from West Cornwall. A friend of mine also informs me that he has seen it in fruit at Kew.

In its barren state, as we usually see it, Lunularia consists of a pale green, somewhat shining frond, furcately divided towards the extremity, and dotted on the upper surface with pores. It adheres closely to the ground by means of abundant rootlets springing from a central rib on the under surface.

Scattered here and there on the fronds are seen shallow depressions or cavities half surrounded by a crescent-shaped ridge, from which the generic name Lunularia, is derived. The depressions are filled with minute yellow-green roundish gemmules, which have the power of developing into fronds, and thus render the plant to some extent independent of sexual reproduction.

These crescent-shaped "apparatus gemmipari," as the "Synopsis" calls them, afford a ready means of identifying

Lunularia, even in the barren state. Analogous structures are to be found in *Marchantia polymorpha*, but in that plant they take the form of a small drinking-glass, or tumbler, with a toothed edge, whilst in Conocephalus and Asterella they are orbicular.

The male receptacles, containing antheridia, are sessile on the upper surface of the frond, as in *Conocephalus* (Fegatella or Marchantia) *conicus*. The latter plant, however, both in the barren state and with the male flowers, may always be distinguished by a peculiar aromatic fragrance which the bruised fronds yield. It is also by no means a weed of cultivation, and is much larger and coarser than Lunularia.

The fructification of our plant consists of four whitish semi-transparent involucres arranged crosswise at the summit of a common peduncle, which is also white and pellucid. It is to this arrangement of the involucres that we owe the obsolete names of Cruciata and Staurophora formerly applied to this plant. Each of the four (which used to be considered as forming conjointly a receptacle, as in Marchantia) is bilabiate at the apex, and contains a capsule which ultimately projects beyond the apex on a hyaline pedicel, and splits into four linear valves—precisely as in Jungermannia.

It will thus be seen that Lunularia forms an interesting link between the Marchantiæ and the Jungermanniæ—approaching the former by the structure of the frond, the disposition of the antheridia and the presence of special "apparatus gemmipari," and coming near to the latter in the delicate pellucid fruitstalk, the absence of a true female receptacle, and in the capsules, which do not burst irregularly, as in Marchantia and its allied genera, but normally into four valves, as in Jungermannia and the forms akin to it.

And it will be obvious also that there is ample reason for separating it from Marchantia, under which it was formerly included, and constituting for it a separate genus. It is, in fact, considered by some botanists as forming the type of a distinct subsection of the Marchantiaceæ, called Lunularieæ, of which subsection the foreign Plagiochasma is the only other genus known to me.

In conclusion I might suggest that records of *Asterella hemisphærica* may occasionally refer in reality to the sterile state of Lunularia, the mistake arising from an idea that the specific name hemisphærica refers to the shape of the gemmiferous cavities, whereas in reality it is intended to denote the shape of the capsule of Asterella.

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 260.)

PART IV.—HISTORICAL.

The species of Pilobolus have been very much confused together, and many of the previous records are quite useless from the impossibility of deciding to which species they refer.

The earliest record which I have been able to find of a species belonging to this genus is met with in the works of our own famous botanist, John Ray. In his Historia Plantarum[1] (1688) occurs the following passage, which, on account of its importance, I will quote in full :—

"E Catalogo huc tranſmiſſo *Anno* 1680, quem compoſuit eruditiſſimus vir et conſummatiſſimus Botanicus D. Johannes Baniſter Plantarum à ſeipſo in Virginia obſervatarum.

"Fungus (a ſtercore equino) capillaceus capitulo rorido, nigro punctulo in ſummitate notato. Ex recenti fimo noctu exoritur cauliculis erectis, vix digitum longis, capillorum inſtar tenuibus nec minùs denſis ſeu confertis. Singuli Cauliculi parvulo globulo aqueo coronantur, qui in ſumma ſui macula parva nigra Limacis oculi ſimili inſignitur."

It is then recorded and figured by Plukenet[2] as "Fungus *Virginianus* ex ſtercore equino capillaceus, canus, capitulo rorido, nigro punctulo in ſummitate notato, D. *Baniſter*." From this figure and Ray's description, it is evident that the species they had in view was similar to, if not identical with, that which was afterwards called *Mucor roridus*.

The first record of this fungus as British is found in Ray's Synopsis[3] (1696), in a list of plants observed and communicated by Mr. James Petiver, who remarks "*This I have obſerved on Horſe-dung about* London," and refers to Plukenet's figure.

[1] Hist. Plant., vol. ii., p. 1928.

[2] Almagestum, p. 164; Phytographia, pl. 116, fig. 7.

[3] Syn. Meth., ed. ii., Appendix, p. 322.

This record, therefore, may be considered to have reference to *P. roridus*. It is repeated by Ray in his Historia Plantarum[1] (1704), and again in his Synopsis[2] (1724), and by Petiver in his Gazophylaceum[3] (1711), where he gives a figure identical with that of Plukenet.

Another mention of a fungus belonging to this genus (the earliest known to Coemans, in his review[4] of the abundant literature of the subject up to his time) is due to Henry Baker (1744), who, in his Natural History of the Polype Insect,[5] describes a number of small vase-like plants, filled with a clear liquid, and crowned with a black ball; these, which he found on mud brought from the Thames, were undoubtedly a species of Pilobolus.

In 1764 Otto Müller discovered, and afterwards described and figured[6] a Pilobolus, under the name of "Kristall-Schwämmchen;" he imagined that it was in part an animal and in part a plant, and even in part a crystal, thus partaking of all three kingdoms of Nature. The singularity of this view accounts for the widespread attention which was given to his discovery.

Scopoli, in 1772,[7] first gave a name to the plant, which showed that he recognised at that early time its true affinities. He called it *Mucor obliquus*, from the oblique manner in which the stem frequently springs from the side of the basal reservoir, but his description is insufficient to enable us to recognise the species.

Withering, in his Botanical Arrangement[8] (1776), quotes Petiver's plant from Ray's Synopsis, and bestows upon it the name of *Mucor roridulus*.

In Weber's Primitiæ Floræ Holsaticæ (1780), p. 110, Scopoli's species is placed in a new genus under the name of *Hydrogera crystallina*.

But the first good description of the genus was given by Tode, in 1784,[9] who imposed upon the species the name of *Pilobolus crystallinus*, by which it is now known. The generic name is a translation of the title "Hutwerfer," under which

[1] Hist. Plant. vol. iii., p. 24.

[2] Syn. Meth., ed. iii., p. 13.

[3] Gazophyl., pl. 105, fig. 14. For the quotations from Petiver and Plukenet I am indebted to Mr. Jas. Britten.

[4] Monographie du Genre Pilobolus, pp. 7 ff. (1861.)

[5] Chap. xi., pl. 22, figs. 9, 10.

[6] Kleine Schriften aus der Naturhist., p. 122, pl. 7.

[7] Flora Carniolica, ii., 494.

[8] Bot. Arr., ii., p. 784.

[9] Schrift. der Naturf. Berlin. Gesell., v., 46, pl. i.

he first described it (*l.c.*) He included it again in his Fungi Mecklenburgenses selecti[1] (1790), where he mentions a variety "capsula solum hydrophora," which appears to be merely a stem from which the sporange had been projected, and was replaced by a pellucid drop.

Species of Pilobolus are then successively mentioned by Dickson (1785), who figured one[2] under the name of *Mucor urceolatus*; by Bolton[3] (1789), who, besides figuring under that name a form resembling a badly grown *P. Kleinii*, adds another[4] identical with Petiver's as *Mucor roridus*; by Bulliard[5] (1790) and by Vahl[6] (1792).

Persoon (1796) gives an excellent description of *P. crystallinus* in his Observationes Mycologicæ,[7] accompanied by an imperfect figure; and in his Synopsis Methodica Fungorum[8] he mentions both the latter and *P. roridus*, which he considered to be a doubtful species. He appears to have fallen into the error of imagining the sporange to be projected without the columella.

Link (1809) was the first who attributed[9] the projection to the true cause, namely, the tension of the swelling below the sporangium, an explanation which is endorsed by De Bary in his just published work[10] (1884).

Ehrenberg, in 1823, published in Kunze und Schmidt's Mykologische Hefte[11] an account of some observations he had made upon *P. crystallinus*, in which, while searching for Otto Müller's "worm," he noticed a curious movement of yellowish particles arranged in a snake-like form in a drop of water which occupied the summit of the sporange. He inclined to the opinion that this was what Müller had seen, but we know that in this he was mistaken. It is probable that it was only a small stream of the contents of an immature sporange protruding through an injured part into a "dew-drop," and the "slow, steady, circling motion" which so excites his wonder, is nothing more than evaporation of the drop might easily produce.

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1 Part i., p. 41.
2 Fasc. Plant. Crypt. Brit., i., 25, pl. 3, fig. 6.
3 Hist. Fung. pl. 133, fig. 1.
4 *L.c.*, pl. 132, fig. 4.
5 Champ. i., 111, pl. 480, fig. 1.
6 Flor. Dan., vi., fig. 1080.
7 Part i., 76, pl. 4, figs. 9—11.
8 Part i., pp. 117—8.
9 Obs. Plant., part 4.
10 Vergleich. Morph. u. Biol. Pilze, p. 77.
11 Myk. Heft., ii., pp. 70-6.

All the authors mentioned so far correctly placed the genus in the immediate vicinity of Mucor. Fries, however, in 1823, considering that it was nearly allied to Sphærobolus and Thelebolus, placed it[1] with them as a subdivision of the Gastromycetes, under the name of Carpoboli. In this error he was followed by Berkeley, in the English Flora[2] (1836); but four years previously, in 1832, Fries had already discovered his mistake, and restored it again to the Mucorini.[3]

Up to this time only the two species already mentioned, *P. crystallinus* and *P. roridus*, were generally known, although in 1828 Montagne had described[4] a third, to which he gave the name of *P. œdipus*, on account of the basal reservoir which is so conspicuous a feature of that species. He repeated it again in 1856, in his Sylloge, p. 299.

In 1837 Corda instituted[5] the group Pilobolideæ, in which he included Pilobolus and Chordostylum; in 1842 he added to the group Pycnopodium and Caulogaster,[6] including in the former genus, as *Pyc. lentigerum*, a species which he had formerly included in Pilobolus, and which would seem to be merely an abnormal state of *Pilobolus Kleinii*. It will be seen that the Pilobolideæ of Corda is not identical with the Pilobolidæ of Van Tieghem. After Corda's lamented death, Zobel published (1854) from his friend's notes the sixth volume of the Icones, in which, p. 12, is a long account of *P. crystallinus*, containing numerous errors; he seems in particular to have been entirely unacquainted with the true cause of the projection of the sporangium. In his drawings also[7] he represents the interior of the swelling as lined with reticulations of the orange-coloured granules, which no other author has seen, and which are probably only the meridional streams to which I have already alluded, disturbed by the pressure to which the preparation was subjected.

When Cohn published, in 1851, his celebrated monograph "Die Entwickelungsgeschichte des Pilobolus crystallinus," he had before him not that species, with which he was really unacquainted, but the species of Montagne. He figures the characteristic yellow, spherical, thick-walled spores of

[1] Syst. Myc., ii., 308.
[2] Vol. v., p. 231.
[3] Syst. Myc., iii., p. 312.
[4] Mém. Soc. Linn. Lyon, pp. 1—7 *cum ic.*
[5] Icon. Fung. i., p. 22.
[6] *L.c.*, v., p. 18.
[7] *L.c.*, pl. ii., fig. 32.

P. œdipus, and then remarks, with surprise, that Corda had represented the spores of his *P. crystallinus* as elliptic and colourless "in contradiction to nature."

Cesati discovered, in 1850, a species, which he published in the next year under the name of *P. anomalus*.[1]

Bonorden, in 1851, describes[2] a species, under the name of *P. crystallinus*, which on account of its round spores Coemans refers to *P. œdipus*, but which I think there is greater reason for considering a peculiar form of *P. Kleinii*.

In 1856 Currey wrote a note "On a Species of Pilobolus,"[3] which he considered to be *P. roridus*, but his plate and description clearly show that the species he had in view was *P. Kleinii*. He was probably led into this error by Cohn's monograph, which puts forward *P. œdipus* as the true *crystallinus*, but, whatever its cause, it has occasioned serious inaccuracies in the British records. Leveillé, in 1826, had fallen into the same error, giving, according to Van Tieghem, the name of *P. roridus* to a mere form of *P. Kleinii*. Currey also erroneously attributed the projection of the sporangium to the eversion and upward pressure of the columella.

In the "Outlines of British Fungology" (1860) Pilobolus is omitted altogether.

In 1861 Coemans published his "Monographie du Genre Pilobolus," in which he summarises all that had previously been done on this subject, and gives a list of all the species referred by other authors to this genus. He considers *P. crystallinus* and *P. œdipus* to be the only certain species; *P. roridus* he regards as doubtful, *P. lentigerus* he refers, wrongly, to *P. œdipus*, and *P. anomalus* he places in the genus Ascophora, by the name of *A. Cesatii*.

(To be continued.)

[1] Klotzsch, Herb. Myc., No. 1542, *cum descr.*
[2] Hand. Myk., p. 128, fig. 203.
[3] Journal Linn. Soc., i., p. 162, pl. 2.

Dr. J. J. Woodward, whose excellent photo-micrographs, produced during his connection with the Army Medical Museum, Washington, are well known, is dead. Dr. Woodward many years since undertook an examination of the microscopic test plates ruled by the late F. A. Nobert, of Prussia, in which he was eminently successful. He subsequently made a large series of photo-micrographs of test objects, such as blood corpuscles, on a micrometer plate, so that the diameters could be estimated by inspection, his latest work being the production of photo-micrographs of the diatom *Amphipleura pellucida*.—*Athenæum.*

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Part II.—"*The Inductions of Biology.*"

EXPOSITION OF CHAPTER III.—FUNCTION.

BY C. H. ALLISON.

Function may be defined as "the totality of all vital actions." It originates structure, for the vital activity of every germ obviously precedes the development of its structures; the lowest Rhizopods exhibit, says Professor Huxley, "Life without Organization," *i.e.*, Function without Structure.

Function is divided into various kinds, commencing with the simplest. It is Statical and Dynamical according to the distributions of force which an organism opposes to the forces brought to bear upon it. Again, Function is divisible into the Accumulation of Force—latent in food; the Expenditure of Force—latent in the tissues and certain matters absorbed by them; and the Transfer of Force—latent in the blood.

But these admit of subdivision: Accumulation of Force, including Alimentation and Aëration, of which the former consists of the Prehension of Food and its Transformation into blood; Transfer of Force, including the Circulation (vascular and lymphatic); and the Expenditure of Force, including Nervous and Muscular Actions. There are also the subsidiary Functions, Excretion and Exhalation; to which add, that the general physiologist considers Functions, as correlatives of tissues, and that Concrete Physiology considers special Functions as ends of special organs. The first induction is that complexity of Function is the correlative of complexity of Structure; organisms having distribution of parts have a concomitant distribution of actions. The second generalization is that Functions, like Structures, arise by progressive differentiations; the first differentiation is between Endoderm and Ectoderm, and progresses with higher forms of life.

Similar progressive differentiations take place in the developing Embryo. This progress is from general, indefinite, and simple, to special, definite, and complex, termed by Milne-Edwards the Physiological division of labour.

The progress towards specialization of Functions is accompanied by their becoming more mutually dependent, and less specialized parts are more capable of performing vicarious Functions than the more specialized, and such animal tissues as are vicarious have conspicuously cellular composition.

Something like *a priori* reasons may be reached for these *à posteriori* conclusions:—From evolution we know that life comes before organisation. Organic matter in a state of homogeneous aggregation precedes matter in a state of heterogeneous aggregation, and as passing from a structureless to a structured state is a vital process, it follows that vitality existed while yet there was no Structure.

From the definition of life we know that inner actions become so adjusted as to balance outer actions, and as every advance in life is the better adjustment of inner to outer actions, and as increasing complexity of structure is only a means to that end, it follows that Function determines Structure; this is also true where modified Structure otherwise produced apparently initiates modified Function, for it is only where such so-called spontaneous modification of Structure subserves some advantageous action that it is permanently established. Heterogeneity of Structure and of Function are obviously connected.

The progress of Structure and Function is parallel, for if Structure advances from the simple and general to the complex and special, so too must Function.

EXPOSITION OF CHAPTER IV.—WASTE AND REPAIR.

Waste and Repair are insignificant in the Vegetal Kingdom, either by consumption or reconstruction of tissue or by restoration of lost parts; they are slight in lower animals, in reptiles, and even in fish, though active, but are great in active, hot-blooded animals, and such animals waste most when most in action, hybernating animals waste little, and in invalids waste diminishes as expenditure of force declines.

The waste and repair of special parts is also in proportion to their activity, as is proved by common experience.

"Repair is everywhere and always making up for waste," though the two processes vary in their relative rates, and reintegration is proportionate to disintegration, the organs continually taking up fresh materials from the blood enriched by food.

The rapidity with which wasted organs recover, varies with the age and reparative power of the individual, and function carried to excess may never be made up.

The restoration of lost or injured parts is another kind of repair; it is greatest in the lowest organizations and least in the highest, from the Hydrozoa, in which the smaller part will produce the greater, to birds and mammals, in which wounds only can be healed. There is complete harmony between the first of the above inductions and deduction from "First Principles," viz., "that whatever amount of power an organism expends in any shape is the correlate and equivalent of a power that was taken into it from without." The power required to raise the elements of the complex atoms (of food) to a state of unstable equilibrium is given out in their falls to a state of stable equilibrium, and "the loss of these complex unstable substances is proportionate to the quantity of expended force." A like relation may be deductively inferred between the activity and waste of special parts.

The deductive interpretation of Repair, though less easy, appears to be in harmony with First Principles; it would be simple if the blood contained (which it does only in part) units like those of each organ. The true explanation seems to be, that compound units possess the power of moulding adjacent fit materials into units of their own form. This power is called Katalytic Action.

The repair of wasted tissue may be considered due to forces analogous to those by which a crystal reproduces its lost apex in a solution like that from which it was formed, which forces are called "Polarity"; and the repair of lost parts is caused by similar actions, the aggregate forces of an organism controlling the formative process going on in each part.

The form of each organism seems due to some peculiarity in the constitution of its units, and living particles have an innate tendency to arrange themselves into the shape of the organism to which they belong.

What, then, are these Organic Units? Not chemical Units; for if so, as millions of plants and animals are mainly built up of such complex atoms, there would be nothing to account for unlike forms. Neither are they Morphological Units, which are cells, for some creatures (as the Rhizopod) do not consist of cells; the formation of cells themselves is to some extent only a manifestation of this same peculiar power. We must, therefore, conceive this Organic Polarity as possessed by certain intermediate units, which may be called Physiological Units, and must suppose that Chemical units combine into these infinitely more complex Units which in each Organism have distinctive characters.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(*Continued from page 267.*)

ORCHIDACEÆ (*continued*).

SPIRANTHES.

S. autumnalis, *Rich.* (*Ophrys spiralis*) *Purt.* *Autumnal Ladies' Tresses.* Native: In old pastures. Rare. August to October.

II. In a field, in the road from Bidford to Broom, and at Snitterfield near to the Lodge Farm, *Purt.*, ii, 425. In a field crossed by the footroad from Warwick to Hampton-on-the-Hill, *Perry Fl.* Corner of Badger's Wood, near Stratford, *W. C.*, *Herb. Perry.*

LISTERA.

L. ovata, *Brown.* *Common Tway-blade.*

Native: In damp woods and on damp heathy roadsides. Locally common. May to July.

I. Sutton Park; Hartshill Hayes; Oldbury; Baddesley Ensor; Bentley Park; Kingsbury Wood; New Park, Middleton; lanes about Elmdon and Olton Pool; Hampton-in-Arden; lanes about Solihull and Shirley; pastures near Knowle Railway Station.

II. Near Leamington; plantation near Saltisford Common, *Perry Fl.;* common near Rugby, *R. S. R.*, 1877; Salford Priors! *Rev. J C.;* Honington, *Newb.;* Alveston Pastures; Oversley Wood; Ragley Woods; woods near Moreton Bagot; Drayton Bushes; Baddesley Clinton, &c.

NEOTTIA.

N. Nidus-Avis, *Rich.* *Bird's-nest Orchis.*

Native: In woods and copses. Rare. May, June.

I. Middleton Wood, *Bree*, *Purt.* ii, 426. Kingsbury Wood! Bushy Wood, *Bree*, *Mag. Nat. Hist.*, iii, 165. Coppice near Elmdon Hall.

II. Alveston Pastures, *W. C.*, *Herb. Perry.* Ragley and Oversley Woods, *Purt.*, ii., 426. Prince Thorpe Wood, *L. Cummin.* Ufton Wood, *H.B.* Fletcher's Copse, Gaydon; Longbrook Copse, Bishop's Itchington; *Bolton King.* Combe Abbey Wood.

EPIPACTIS.

E. latifolia, *Sw.* *Broad-leaved Helleborine.*

Native in woods, copses, and bushy waysides. Very local. July, August.

I. Coleshill, *Bree*, *Mag. Nat. Hist.*, iii, 165. Barber's Coppice, Hampton-in-Arden, *Rogers*; Kingsbury Wood; heathy waysides near Packwood.

II. (*Serapias latifolia*) Ragley Woods, *Purt.* ii, 424; Allesley; Leek Wootton, *Bree*, *Purt.* iii, 380; Waverley Wood, Kenilworth; Edge Hill Wood;* Warnbury Wood,* *T. K.*, *Herb. Perry.* Whitley Wood,* *T. K.*, *Herb. Bab.* Hill Wootton; Rounsel Lane, Kenilworth, *H. B.* Fletcher's Copse, Gaydon, *Bolton King.* The Ridings, near Combe Abbey; Cubbington Wood, near Stoneleigh; Warnbury Wood, Stoneleigh; Snitterfield Bushes; Austey Wood, Wootton Wawen; Oversley Wood. Tile Hill Woods, near Berkswell.

The plants from the localities marked thus (*) are labelled *E. media* by the collectors, a species which does not occur in this county so far as my own observations serve. This species, *E. latifolia*, varies much in the shape of the leaves, in the flowers being in dense or lax racemes, and in the basal ridges being rugose or smooth, the latter character being remarkably inconstant, as I find that of two plants from the same rootstock one will have these processes smooth and the other distinctly rugose plicate. Plants from some of the above districts have been submitted to Mr. J. G. Baker, F.R.S., and he pronounces them to be *E. latifolia*, thus confirming my own opinion.

E. palustris, *Crantz* (*Serapias longifolia*, *Purt.*). *Marsh Helleborine.*

Native: in bogs and marshy places. Very rare. July.

I. Bogs, Coleshill, &c. *Bree, Mag. Nat. Hist.*, iii, 165.

II. Oversley Wood. *Purt.* ii, 429.

I have searched both these localities many times, but have never been successful enough to find this plant in either.

CEPHALANTHERA.

C. ensifolia, *Rich.* *Sword-leaved Helleborine.*

Native: In woods. Very rare. May, June.

II. (*Serapias ensifolia.*) Oversley Wood! Ragley Woods, *Purt.*, ii, 428. In a thicket, Wixford Lane, *Purt.*, iii, 380.

This was very abundant in Oversley Wood in 1880—83.

IRIDACEÆ.

IRIS.

I. fœtidissima, *Linn.* *Fœtid Iris.* *Roast Beef Plant.*

Native: In woods, copses, and marly banks. Rare. June, July.

II. Alne Hills, *Rufford*, *Purt.*, i, 61. Grove Park, *Pratt*, *Herb. Perry.* Chesterton Wood! Compton Verney; Beausale. *H.B.* Oversley Wood (abundant); Drayton Rough Moors; on marly banks, bridle road from Billesley to Wilmcote.

I. Pseudacorus, *Linn.* *Yellow Water Iris.*

Native: In Marshes, by rivers, streams, and pools. Locally common. May, June. Area general.

I have only noticed the var. β, *acoriformis* in the county.

CROCUS.

C. nudiflorus, *Sm.* *Naked-flowering Crocus.*

Native: In old pastures. Very rare. October.

II. Pigwell fields and Lammas fields, near Warwick, *Perry Fl.*, 4.

[*C. vernus*, All. Is recorded from near Sheldon and Marston Green, by the *Rev. J. Gorle*, probably a mere waif or outcast from gardens.]

AMARYLLIDACEÆ.

NARCISSUS.

N. Pseudo-narcissus, *Linn.* *Daffodil.* *Lent Lily.*

Native or denizen: In woods and pastures. Locally abundant. April, May.

I. Near Sutton Coldfield towards Middleton! *Ray Cat.* (ed. 2), 219. Covers almost a whole field on the road from Birmingham to Sutton. *With.* (ed. 7), 420. Sutton Park, *A. W. Wills.* Doe Bank near Sutton; Wylde Green; abundant in Trickley Coppice, Middleton; pastures near Penns; pastures near Elmdon; pastures, Shirley Heath, &c.

II. Studley and Sambourne in great plenty, *Purt.*, i., 168; Kenilworth; Honiley, *Y. and B.;* Haywoods, etc.

[The var. *major* is sometimes found in some abundance as near Elmdon and in Wedgenock Park, Warwick, but is merely an introduced plant.]

N. biflorus, *Curt.* *Two-flowered Narcissus.*

Alien: In pastures. Very rare. April, May.

II. In the Lammas fields, Warwick, *Perry Fl.*, 29; Old Park, Warwick, *Herb. Perry;* Haseley, *Y. and B.*

N. poeticus, *Linn.*

Alien: In old pastures. Very rare. April, May.

I. A field in the parish of Fillongley is full of it. Some of the flowers are single, others double, probably not truly native; *W. T. Bree, M.SS., N.B.G.S.* In a field near Blaber's Hall, *Wats., Cyb. Brit. Comp.*, 580.

[*Narcissus incomparabilis* occurs semi-wild at Guy's Cliff, but has probably been at one time cultivated in the gardens there.]

[*Leucojum æstivum*, Linn. *Summer Snowflake.* Is recorded as probably wild by the side of the Avon near Stratford. No one appears to have found this since Purton's time. Once found above Rugby Mill, *Rev. A. Blox, N.B.G.*]

[*L. vernum.* Warwickshire. *Top Bot.*, page 385. I can find no other record for this plant in the county.]

GALANTHUS.

G. nivalis, *Linn.* *Common Snowdrop.*

Denizen; In copses and on banks. Rare. February to April.

I. Packington, *Aylesford, B.G.*, 634. Wood near Middleton Hall; coppice near Oldbury Hall; coppice, canal bank, near Olton Pool.

II. On the side of the ridgeway, *Purt.*, i, 170. In a field near Wedgenock Park, Warwick, *Perry Fl.*, 28. Golden Green Wood, Warwick, *T. K., Herb. Brit. Mus.;* Old Park, Honily, *Y.* and *B.*

DIOSCOREACEÆ.

TAMUS.

T. communis, *Linn.* *Black Briony.*

Native: In woods, copses, hedges, and bushy places. Common. June to August. Area general.

TRILLIACEÆ.

PARIS.

P. quadrifolia, *Linn.*

I. Lockes (Loaches) Rough, near Coleshill, *Aylesford, B.G.*, 625. In a wood at Packington Outwoods, *Perry Fl.* 37; Bannersley Rough! Coleshill; Fillongley, *Bree, Mag. Nat. Hist.*, iii, 164; Trickley Coppice, and New Park, Middleton; Hartshill Hayes; Gin Wood, Oldbury; coppice, near Solihull; Chalcot Wood, near Umberslade.

II. Spernall Park, *Purt.*, i, 202; Ufton Wood! near Wroxall Abbey! Claverdon, *Herb. Perry;* Crackley; Rowington, *Y. and B.* Plentiful in Combe Wood! *R. S. R.*, 1877; Lodge Woods, Salford Priors, *Rev. J. C.*

LILIACEÆ.

[*Polygonatum multiflorum*, All. Mayfield Lane, Snitterfield, *W. C. Herb. Perry.* Single specimen, Honington, *Newb.*]

[*P. officinale*, All. Near Haseley, *H.B.*
Neither of these plants is more than a casual.]

CONVALLARIA.

C. majalis, *Linn.* *Lily of the Valley.*

Native: In old woods. Rare. May, June.

I. Bentley Park! *Bree, Mag. Nat. Hist.*, iii, 164. Hoare Park, near Shustoke; Kingsbury Wood; Shelly Coppice. Abundant here but rarely flowering.

II. Haywoods! *Bree, Purt.*, i, 174. Allesley and Corley, *Bree, Mag. Nat. Hist.*, iii, 174. Chase Woods; Haseley Wood; wood near Alcester, *Herb. Perry;* The Grove, Stoneleigh Park, planted; Austey Wood, near Wootton Wawen.

[*Asparagus officinalis*, Linn. Coton End. Established on a wall for many years, *Herb. Perry.* This is still there, but does not flower.]

[*Lilium Martagon*, Linn. A single plant pointed out by Mr. Townsend, in a copse by the Stour, near Tredington, *Newb.*]

FRITILLARIA.

F. Meleagris, *Linn.* *Fritillary.*

Denizen: In old pastures. Very rare. April, May.

I. Abundant in the Fritillary Fields, near Tamworth, 1879. *E. De Hamel.*

II. Near the Abbey Wroxall, *W.G.P.*, *Herb. Perry*, 1839. This has not been seen here for some years.

"Mr. W. G. Perry found the white-flowered variety in a meadow by the roadside opposite to Wroxall Abbey," *Baxter.*

TULIPA.

T. sylvestris, Linn. *Wild Tulip.*

Alien: In old pastures. Very rare. April.

I. In meadows by the Bourn at Shustoke, *Bree.*, *Purt.*, iii, 381.

II. Allesley, *Bree*, *Purt.*, i, 172. Meadows near Wroxall Abbey, *H.B.* Rowington, *Y.* and *B.* Pigwell Fields near Warwick, *Herb. Perry.* Still to be found in the last station, but very rarely flowering.

GAGEA.

G. lutea, *Ker.* *Yellow Star of Bethlehem.*

Native: In old pastures near streams. Very rare. April.

I. Sheldon, 1837, *Rev. J. Gorle.* Banks of a stream near Elmdon, near the Cock Inn; banks of the Tame, near Curdworth.

ORNITHOGALUM.

[*O. umbellatum*, Linn. *Common Star of Bethlehem.*

Alien: In old pastures. Very rare. April, May.

II. Near a pond in Godfrey's Lammas, Warwick, *Perry*, 1817. Meadows by the Avon, Warwick, *Bree*, *Mag. Nat. Hist.* iii, 164. Osier bed opposite the church, Warwick, *H.B.*, *Herb. Perry.*]

[*O. nutans* is recorded from near Offchurch, but cannot be more than an escape from cultivation. I have seen it in Sutton Park under like circumstances.]

SCILLA.

S. nutans, *Sm.* *Wood Hyacinth.* *Blue Bell.*

Native: In woods, copses, on hedge banks, and in waste places. Very common. Area general.

The white variety occurs in most of the localities where the plant is abundant, more especially in shady woods.

ALLIUM.

A. vineale, *Linn.* *Crow Garlick.*

c. compactum. Thuill.

Native: In corn and other cultivated fields, in marly or calcareous soils. Local. June, July.

II. Harbury, *Y. and B.*; common about Tredington, *F. Townsend.* Abundant in cornfields near Binton; cornfields near Drayton Bushes; cornfields, bridle road from Billesley to Wilmcote; cornfields near Ullenhall, and Studley.

A. oleraceum, *Linn.* *Field Garlic.*

Native: In bushy pastures, and amongst corn. Rare. July, August.

II. In a field by Rosall (Rose Hall) *Purt.*, i, 169; near Leamington, *Perry*, 1817; near Exhall, in a plantation, *Perry Fl.*; calcareous fields west of Stratford-on-Avon; Grafton, *Dr. Lloyd*, *Herb. Perry*; Blackwell Bushes, specimen from *Miss Townsend*, *Bolton King*; bushy pastures, near Honington.

A. ursinum, *Linn.* *Ramsons.*

Native: In damp woods, by rivers and streams, and on damp shady banks. Locally abundant. May, June.

I. "Several pastures near Penn's Mill at Erdington! abound so much with this plant as to be called the Garlic Meadows." *With.* (ed. 7), 424. Banks at Hay House, Castle Bromwich, in great plenty, *Purt.*, i, 179. Shady banks near Moor Hall, Sutton; New Park, Middleton; very abundant, Erdington; banks of the Tame near Water Orton; Kingsbury Wood; Bentley Park; Brook End, Hurley; Blythe Bridge, near Solihull; footway from Knowle Station to Hockley; Olton Pool, etc.

II. Spernall and Oversley Woods! *Purt.*, i, 170. Honiley Brook, *Y. and B.* Salford Priors, *Rev. J. C.*, Binton; Red Hill; Drayton Bushes; Wilmcote; Henley-in-Arden, etc.

NARTHECIUM.

N. ossifragum, *Huds.* *Bog Asphodel.*

Native: In bogs and marshy places. Very rare. July, August.

I. Coleshill Bog! *Purt.* i, 172; south side of Bannersley Pool, *Perry Fl.*; Sutton Park, dying out in this locality; Hill Bickenhill, abundant; near Marston Green, 1883.

COLCHICUM.

C. autumnale, *Linn.* *Meadow Saffron.*

Native: In damp pastures; woods and copses. Locally abundant. August, September.

I. Packington, *Aylesford*, *B.G.*, 635. Beanfield meadows near Sutton Coldfield, *J.P.*, *M.S. note B.G.* Sheldon! *Rev. J. Gorle.* Near Rowington, abundant, *W. B. Grove.* Abundant in pasture near Water Orton Railway Station; pasture at Waste Mills, Small Heath; near Birches Green, Hockley.

II. Barford Meadows, *Perry*, 1817. Norbrook, *Perry Fl.* Near Long Compton, *Baxter.* Iddicote Wood, *Rev. J. Gorle.* In a meadow about one mile from Brinklow on the Anstey Road, *Rev. A. Blox, M.S. note in Midland Flora.* Pinley, *T. Kirk, Phyt.*, ii, 971. Oakley Wood, *Y.* and *B.* Armscote Meadows, *F. Townsend.* Alveston Pastures; meadows by Binton Bridges; Drayton Bushes, Drayton Rough Moors; Oversley Wood; Bearley Bushes; meadows about Ullenhall; in woods and meadows near Allesley and Meriden.

Var. flore-albo. Meadows, Whitacre. *Bree, Purt.*, i, 183.

(To be continued.)

Review.

Manual of the Mosses of North America. By Leo Lesquereux and Thomas P. James; with six plates illustrating the genera; pp. 447, royal 8vo.; 21s. Boston: S. E. Cassino and Co.

This work is a record of the researches into the moss flora of North America by Sulivant, Austin, Lesquereux, James, E. Hall, and other eminent bryologists, and is one which every bryological student should possess. To all bryological students it will be valuable, but to the student of botanical geography it will present many points of great interest; and an attentive comparison of this work with Schimper's "Synopsis Muscorum Europæorum" will afford much matter for scientific speculation. In going through the pages of this work one is struck with the fact that there are so many species common to both Europe and America, clearly showing that the two floras, now so widely separated, have a common origin, and that they are part of that great and ancient Scandinavian flora whose descendants now people the world. Still, though there are strong lines of affinity in the two floras, a careful analysis of the Manual reveals the fact that there are many and marked differences in the two floras. In the Manual we have descriptions of about 900 species and varieties, and of these 385 species are non-European. The following analysis will show the whole matter at a glance; in this I have given the genera in the order in which they appear in the Manual; and the first column of figures represents the total number of species of each genus as recorded in the Manual, the second column gives the total number of non-European species of each genus:—

	Total Species.	Non-European.		Total Species.	Non-European.		Total Species.	Non-European.
Sphagnum	28	9	Desmatodon ..	13	5	Mnium	21	6
Andreæa	3		Barbula	48	19	Cinclidium	2	
Micromitrium ..	3	2	Cinclodotus.. ..	1		Rhizogonium ..	1	1
Ephemerum ..	7	4	Grimmia	28	11	Leptotheca	1	1
Physcomitrella ..	1		Racomitrium ..	11	3	Aulacomnium ..	4	1
Sphærangium ..	4	2	Hedwigia	1		Timmia	2	
Phascum	3		Braunia	1	1	Atrichum	7	3
Pleuridium	5	3	Coscinodon	3	2	Oligotrichum ..	2	2
Microbryum ..	1	0	Ptychomitrium ..	4	4	Psilopilum	1	
Bruchia	14	12	Glyphomitrium ..	1	1	Pogonatum	8	6
Archidium	5	5	Amphoridium ..	5	3	Polytrichum ..	6	
Astomum	4	3	Drummondia ..	1	1	Buxbaumia ..	1	
Gymnostomum ..	4		Ulota	10	3	Diphyscium.. ..	1	
Anœctangium ..	1	1	Orthotrichum ..	33	18	Fontinalis	11	8
Weisia	3	2	Macromitrium ..	4	4	Dichelyma	7	3
Dicranoweisia ..	2		Schlotheimia ..	1	1	Cryphæa	4	4
Oreoweisia	1		Encalypta	8	2	Leptodon	3	3
Rhabdoweisia ..	2		Calyperes	3	3	Alsia	3	3
Cynodontium ..	4		Syrrhopodon ..	2	2	Neckera	11	7
Dichodontium ..	2	1	Tetraphis	2		Homalia	4	3
Trematodon ..	2	1	Tetrodontium ..	1		Meteorium	2	2
Angstrœmia ..	1		Discelium	1		Leucodon	3	2
Dicranella	11	1	Schistostega ..	1		Pterigynandrum ..	1	
Dicranum	23	2	Dissodon	3		Pterogonium ..	2	1
Dicranodontium ..	1	0	Tayloria	2		Antitrichia	2	1
Campylopus ..	11	9	Tetraplodon ..	4	1	Hookeria	3	3
Fissidens	24	15	Splachnum ..	6		Pterygophyllum ..	1	
Conomitrium ..	2	1	Pyramidula ..	1		Fabronia	6	4
Leucobryum ..	3	2	Aphanorhegma ..	1	1	Anacamptodon ..	1	
Octoblepharum ..	1	1	Physcomitrium ..	6	4	Habrodon	1	
Ceratodon	2	1	Entosthodon ..	3	2	Clasmatodon ..	1	1
Trichodon	1		Funaria	9	5	Thelia	4	4
Distichium	2		Bartramia	8	2	Myurella	3	1
Eustichia	1		Conostomum ..	1		Leskea	8	5
Anodus	1		Philonotis	5	3	Anomodon	7	3
Seligeria	4		Catoscopium ..	1		Platygyrium ..	1	
Blindia	1		Amblyodon	1	0	Pylaisia	5	4
Brachyodus.. ..	1		Meesia	4		Homalothecium ..	2	2
Campylostelium ..	1		Paludella	1		Cylindrothecium ..	8	6
Pharomitrium ..	1		Mielichoferia ..	1		Climacium	3	2
Pottia	9	2	Leptobryum ..	1		Orthothecium ..	3	1
Didymodon	3		Webera	19	5	Hypnum	196	85
Leptotrichum ..	7	1	Bryum	42	10			
Trichostomum ..	6	1	Zieria	2				

Some of the species described appear to be separated by very trivial differences, but this is an age of hair-splitting. It would have been interesting, if space allowed, to have called attention to common species that are apparently absent in this flora, such as *Campylopus pyriformis*, *C. fragilis*, and very many others. The descriptions are excellent, and have evidently been carefully worked out. The analysis of the genera will be found of great service, more especially to young students. In addition to this general analysis there is a very useful key to the subgenera of the vast and difficult genus Hypnum. The six plates are ably drawn, and will be familiar to those students who use Schimper's Synopsis, the author of that work having borrowed them without acknowledgment. The type, printing, and whole get-up of the work is excellent, and does great credit to both author and publishers. JAMES E. BAGNALL.

A SUMMER CAMPAIGN.

Four Botanists met on a cliff by the sea,
Old friends who had trudged over forest and lea
In search of the wonders that lurk in the bog,
Or cling to the rock and the moss-painted log.

The hot days of August were just in their prime,
The wasps were abundant, the dust was sublime,
But the Botanists, each in his own summer rig,
Replied to Dame Nature "We don't care a fig!
You may boil, you may roast, you may pepper or drown,
We're here for a week, we've escaped from the town,
We'll rifle your treasures on sand-hill and fen,
We'll find out your secrets, the Where and the When,
But the How and the Why we acknowledge are harder,
One may dine at an inn but not pry in the larder.
The rare long-leaved Sundew we'll hunt on the moor,
And *Statice caspia* down by the shore,
Where the shrubby *Suæda* just fringes the land
And *Salsola* spreads out his thorns on the sand.
We're in for real work, not a mere boyish game;
So kindly prepare us a welcome, old Dame."

And Nature looked out from her great shining eye,
She dried up the fens and she polished the sky,
She soothed the sea wind to a sweet-tempered breeze
That refreshed the white sand-plains and fanned the hot trees,
She opened the doors of her treasure-house wide,
From her well-beloved sons she had nothing to hide.
"Come search me, and count me, and read me," she said,
"I'm a riddle profound that has never been read.
You that love me unravel the threads of my life
So blended in beauty, so knotted with strife.
See! I give you *carte blanche*, use my tools or my toys,
They are all at your service; go at it, my boys!"

The Botanists laid down their plans for each day,
And carried them out in a business-like way.
From Bawsey and Roydon and Dersingham fen
To Heacham, Holme, Ringstead and Huns'ton again,
They ransacked the land and they searched by the sea,
And brought back their vasculums filled with *débris;*
Rhynchóspora alba and *Myrica gale*,
And *Triticum repens*, the blue *littorale*,
With *Psamma*, *Cakile*, and *Glaucium* and *Phleum*,
So mixed and so many the eyes that would see 'em
Had need to be sharp with the practice of years;
But a Botanist's eyes are in league with his ears,
He knows by the rustle, the crunch, and the crack,
One-half of the species that lie in his track.

Lactuca virosa they found on the sand,
And a rare little Bladderwort further inland;
There were regions where *Sphagnum* and *Drosera* spread
Like a rich Turkey carpet in yellow and red.
There were fens full of Cranberry, Sea-rush, and Reeds,
Where the snipe makes his home and the bittern still breeds,
Where the blackcock was flushed, and the sandpiper ran,
And the stealthy brown adder makes war upon man,
And the lizard slid nimbly through heather and fern,
Or lay like a stick by the slow-gliding burn;
Where *Helix virgata* half covered the grass,
And the pale rayless *Aster* the muddy morass,
Where *Osmunda* sat throned in a leaf-sheltered nook,
And the slender *Œnanthe* peered up from the brook.
Salicornia, *Narthecium*, *Pinguicula*, most
Of the life that is anywhere seen on the coast
Or the heaths or the bogs of Old England was there,
And the Botanists found it, and touched it with care.
Not theirs the rude culture that grabs at all cost,
E'en the last fading relics of forms nearly lost.
True lovers of Nature, they would not destroy
The wild beauties she nursed with such pride and such joy.

So the hours and the days sped away on swift wings,
And the end came at last, as to all pleasant things,
And the Botanists parted, each went on his way;
If such meeting were ever again, who could say?
The chances of life were against it they knew,
But their hearts were at one and their friendship was true.
And in life or in death, they all swore by St. Dunstan,
They'd remember those days round the red cliffs of Huns'ton.

F. T. MOTT.

August 23rd, 1884.

The names of the boys: E. F. Cooper, F.L.S.; C. W. Cooper, M.B.; J. E. M. Finch, M.D.; F. T. Mott, F.R.G.S.

METEOROLOGICAL NOTES.—August, 1884.

The barometer was generally high during the month, though towards its close it showed a downward tendency. From the 1st to the 27th, readings ranged between 29·80 and 30·30 inches. The weather during this period was very fine, with but little rain; there were, however, heavy deposits of dew. The temperature was unusually high, and the somewhat rare occurrence of a maximum of 80 degrees or upwards on six consecutive days is a feature of the past month. The highest readings were—at Loughborough, 89°1 on the 8th, and 88°8 on the 11th; at Strelley, 85°9 on the 11th; and at Coston Rectory, 84°5 on the 11th. In the rays of the sun (blackened bulb, *in vacuo*), 141°6 was registered at Loughborough on the 11th, and 130°0 at Strelley on the 9th. The minimum readings varied during the month between 62° and 35°, the lowest observed being 35°3 at Coston Rectory, and 40°9 at Strelley on the 26th, and 42°3 at Loughborough on the 5th. The mean temperature of the month was about 2 degrees above the average. The number of "rainy days" varied in districts between 7 and 10. The amounts were but small excepting on the 31st, when an inch or upwards fell at some stations. The total values for the month were—Strelley, 2·07 inches; Loughborough, 1·75 inches; Coston Rectory, 1·74 inches. The similarity between the two last-mentioned stations is noticeable, as also the amounts measured on the 31st, being 0·92 inches at Loughborough, and 0·91 inches at Coston Rectory. With the exception of the 9th, thunderstorms were remarkable for their absence. The prevailing winds were westerly, of rather more strength than is usual in August.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

Peronospora alta, Fckl.—This species, which has not, I think, been noted previously in Britain, has occurred here, on the under side of the leaves of *Plantago major*. Fuckel's description is as follows:—Laxly cæspitose, in discoloured spots, grey; hyphæ erect, long, branches about eight, longish, unequal, curved; conidia ovate, large. Fuckel's Symb. Myco., p. 71.—William Phillips, Shrewsbury.

Flora of Warwickshire.—During the past year I have met with the following plants which are additional records for the Flora of Warwickshire:—*Filago minima*, in a gravel pit between Hampton and Berkswell; *Campanula patula*, near Barston; *Specularia hybrida*, in a pea-field beyond Bradnock's Marsh (first record for North Warwickshire); *Aquilegia vulgaris*, Trickley Coppice; *Lysimachia vulgaris*, a fine clump, Middleton Heath. The latter plant is, of course, often, if not always, an escape from gardens, but where I saw it it was evidently well established, there being more than a hundred stems and no house near.—W. B. Grove, B.A.

New British Fungi.—The following Fungi are, I believe, new to the British Flora:—*Mortierella candelabrum*, Van. T., Rech. sur les Muc. pl. 24, fig. 100; this is the first species of this pretty genus recorded as British, except one which I have myself previously mentioned in the "Midland Naturalist," which I could not accurately determine; on decayed wood from Sutton.—*Spicaria elegans*, Harz, on decayed wood, amongst moss, from the same place; this agreed with Saccardo's figure (Fung. Ital. 895), and with the smaller specimens in Corda's Icones, ii., 74.—*Oospora candidula*, Sacc. (Fung. Ital. 880), from Sutton.—*Peziza asperior*, Nyl. (determined by Mr. W. Phillips), on a damp spot in a gravel pit between Hampton and Berkswell. This is mentioned in Mycographia (fig. 51), as occurring in Lapland, Finland, and Austria.—*Phyllosticta cytisella*, on laburnum leaves, from Bradnock's Marsh.—I may also mention that I have found the rare *Peziza Dalmeniensis*, Cooke, again this year in plenty, in the old locality at Sutton.—W. B. Grove, B.A.

A New Vorticella.—Dr. A. C. Stokes describes, in the "American Naturalist" for August last, a new Vorticella, found sparingly on the leaflets of *Ceratophyllum*, in a pond in New Jersey. It is distinguished from all other Vorticellæ by its curious cuticular prominences and the presence of *two* contractile vesicles. Hitherto no member of the genus has been observed with more than one pulsating vacuole. The description is annexed:—*Vorticella Lockwoodii*.—Body when expanded broadly campanulate, not conspicuously changeable in form, the length about equalling the width, tapering posteriorly to the pedicel, and constricted beneath the border of the peristome, which is everted and equal in breadth to the entire length of the body; subspherical when contracted, and anteriorly crenulated; ciliary disc not elevated; cuticular surface bearing numerous scattered hemispherical or ovate elevations, diverse in size, and usually collected about the equatorial region into irregularly disposed series, each prominence enclosing a nuclear nodule; parenchyma finely granular; contractile vesicles *two*, small, spherical, pulsating alternately, one placed somewhat above and in front of the other, near the pharyngeal passage; pedicel four to five times longer than the body. Length of body 50μ; width of pedicel 5μ. Solitary, or few together.

International Scientific Association.—The Editor of the American Journal "Science," advocates the formation of an International Scientific Association, which should hold its congresses at intervals in the different countries of the civilised world. The Editor of the "American Naturalist," while allowing that such a body would have its uses, considers that, unless great care were taken to prevent the management from falling into amateur and unscientific hands, its life would be feeble and its value small, and the time occupied in attending its sessions wasted. And he suggests that it would be easier and safer to expand the existing International Association of Geologists, which originated at Philadelphia at the time of the Centennial Exposition, so as to include all the sciences; the geologists could not be spared from the proposed new body, and they could scarcely attend the meetings of both.

Mineral Ore Deposits.—"The miner of the nineteenth century of our era has but a small increase of guiding light into the mysteries of ore deposits beyond that which directed the labours of the miner who lived nineteen centuries before the birth of Christ. The sum of our knowledge admits of the following grouping, but of little more:—1. Detrital deposits have been formed by the wearing down, under atmospheric influences, of the older rocks containing metallic ores and native metals, and this *débris* has been distributed by aqueous agency. 2. Some ores are diffused through the rocks, and may be regarded as contemporaneous with them. 3. Fissures have been formed through the rocks by mechanical disturbances, acting mainly from below; and as the producing force has been exerted in a given direction, the cracks take for each district a fairly well-defined direction. 4. There appears to be good evidence that the bearings of the lines of rupture through the rocks materially influence the deposition of ores within them. Whether this is due to magnetic or to some other polar force has not been determined. 5. These fissures are the channels through which gases, vapours, or fluids are forced from vast depths, bringing with them metalliferous compounds, which are deposited on the sides of the rents under the influence of mechanical attraction or of crystallogenic force. 6. The ever-varying conditions of subterranean temperature, of electrical currents, of chemical action, and probably of other forces as yet unknown, are constantly producing variations in the phenomena of ore deposits which seriously complicate the inquiry into their formation."—*The Athenæum*, in a review of "A Treatise on Ore Deposits," by J. Arthur Phillips, F.R.S. (Macmillan and Co.)

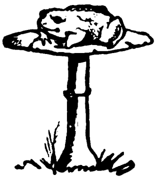
Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, September 2nd, Mr. T. H. Waller in the chair.—Mr. J. E. Bagnall exhibited *Linaria spuria*, *Calamintha menthifolia*, *Nitella flexilis*, *Nepeta cataria*, and other plants from near Stratford-on-Avon; also, on behalf of Mr. S. Walliker, *Lycopodium alpinum*, *L. clavatum*, *Cladonia cornucopioides*, *Hypnum crista-castrense*, and other lichens and mosses from Norway. Mr. W. B. Grove, B.A., exhibited *Torula stilbospora*, *Phoma hederæ*, *Phyllosticta cytisella*, *Glœosporium cytisi*, *Cladosporium fasciculare*, *Protomyces macrosporus*, *Marasmius rotula*, all from Hampton-in-Arden. Biological Section, September 9th, Mr. R. W. Chase in the chair.—Mr. T. Bolton exhibited a new rotifer, a campanulate floscule with only two lobes. Mr. W. B. Grove, B.A., *Mortierella candelabrum*, a species of fungus new to Britain; *Lentinus lepideus*, and *Fuligo varians* (The Flowers of Tan) from a tan yard at Selly Oak; also *Valonia* and *Divi-divi*, materials used in tanning, and *Penicillium* grown from the mothering of the tanning liquor. Mr. J. E. Bagnall, *Pimpinella magna* from near Matlock Bath. General Meeting, September 16th, Mr. T. H. Waller in the chair.—Dr. Cooke was elected a corresponding member of the society. Mr. J. E. Bagnall exhibited for Mr. W. Southall a fine example of *Lycoperdon giganteum*, an edible fungus from his garden at Edgbaston. Also for Mr. R. W. Chase, *Colchicum autumnale*, from Hamstead. Mr. T. Bolton exhibited *Hydrodictyon utriculatum*, found lately near Birmingham. Mr. W. H. Wilkinson, *Spiranthes autumnalis*, *Geranium sanguineum*, *Helianthemum canum*, and other plants from the Little Orme's Head, North Wales. Geological Section, September 23rd.—Mr. Waller exhibited microsections: a Phonolite from among Canadian Apatite, showing a crystal of nosean, preserved by being enclosed in a crystal of felspar; pitchstone from Arran, showing skeleton felspar crystal, with a fringe of hornblende microliths. For Mr. W. R. Hughes, rocks from Bettws and Penmaenmawr, N. Wales. Mr. W. B. Grove, *Hypoxylon concentricum*, a fungus found during the last Banbury excursion; *H. coccineum* with its supposed conidial state, *Isaria umbrina*, forming a curious object something like a mite, and formerly called by Sowerby on that account *Lycoperdon acariforme*; also one of the most curious of British mites, *Tegeocranus latus* (nymph and larva), from Sutton. Mr. Josiah Lowe, foraminifera from chalk: the chalk bought in the ordinary way from a druggist's shop—a pennyworth. Mr. Wilkinson, *Campanula hederacea*, *Jasione montana*, *Origanum vulgare*. *Verbena officinalis*, *Rubia peregrina*, white variety of *Bartsia odontites*, *Melampyrum sylvaticum*, and other plants from N. Wales.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 18th.—Mr. Tylar showed an internal parasite, *Ascaris lumbricoides;* Mr. Hawkes a collection of plants from Solihull, including *Lycopus europæus* and *Phalaris canariensis;* Mr. J. W. Neville, under the microscope, "Cherry-gall" flies, *Cynips quercus folii*, male and female. A paper was then read by Mr. Sanderson, "Notes on the common Frog," which described the egg and the mode of its fertilisation, together with the use of the gelatinous envelope. In the next stage the creature somewhat resembles a fish, and the heart has only one auricle until the development of the lungs. The gradual growth of the tadpole was followed through to the young frog, this stage being reached in about 120 days from the deposition of the egg; the frogs only reach their full growth in the fourth year. Their mode of hibernation and peculiar manner of breathing were described, and current stories of showers of young frogs and of mature ones being found imprisoned in solid rocks and trees accounted for. The paper concluded with a description of our three species and their distribution. August 25th.—Mr. Madison exhibited a specimen of *Helix aspersa* var. *minor*, from Tenby; also *Planorbis corneus*, var. *albina*, from near King's Norton, new to the district; Mr. Deakin, a collection of freshwater shells; Mr. Hawkes, a number of plants from Sutton Park, including *Parnassia palustris*, *Achillea ptarmica*, and *Veronica scutellata;* also the following fungi: *Cystopus candidus*, *Trichobasis labiatarum*, and *Spumaria alba*. Under the microscope, Mr. Tylar showed section of quartz pebble by polarised light, and Mr. Sanderson *Pandorina Morum*. Mr. H. Insley read the second paper of a series on "The Scenery of the district Geologically considered." The paper dealt with the scenery from Great Barr, through Newton Road, West Bromwich, Rowley, Halesowen, Clent, the Lickey Hills, Northfield, and Harborne, to Birmingham. The various formations, their nature, extent, and the causes that had carved out their present contour were described. The paper was illustrated by a series of landscape sketches taken in the field. September 1st.—Mr. Insley exhibited slabs of limestone from Clay Croft openworks, containing trilobite, etc.; on behalf of Mr. Baxter, specimens of hop plant, showing young and mature hops. Mr. Hawkes, specimens of *Colchicum autumnale* and *Alchemilla vulgaris*, the latter attacked by the fungus, *Uromyces intrusa;* Mr. Madison, a case of specimens of *Helix pisana* var. *alba*, var. *lineolata*, and other unnamed varieties, from Tenby; Mr. Insley, lupuline glands of hop under the microscope. September 8th.—Mr. Deakin, a collection of freshwater shells, including *Planorbis albus*, and a very small though full-grown specimen of *Limnæa stagnalis;* Mr. Tylar, specimens of travertine from the Dudley caverns. Under the microscope, Mr. Deakin showed young shells of *Sphærium lacustre*, and Mr. Moore alimentary canal and gizzard of stone-fly. September 15th.—Mr. Rodgers exhibited eggs of stone mite, *Tetranychus lapideus;* Mr. Madison, a striped variety of *Limnæa stagnalis;* Mr. Moore, a case of various sawflies; Mr. Hawkes, a specimen of soapwort, *Saponaria officinalis*, from Great Barr. Under the microscope, Mr. Moore exhibited the alimentary canal of green sawfly, *Tenthredo viridis*, showing parts of butterfly it had preyed upon; Mr. J. W. Neville, palate of *Chiton cinereus;* Mr. Dunn, organisms in condensed tap water.

ON "THE MAMMALS OF LEICESTERSHIRE." *

BY F. T. MOTT, F.R.G.S.



The Mammals which still run wild in this county are few in species and of small size.

It must always be so, wherever civilized man has long been settled, and has enclosed and cultivated the land. Man is himself the Royal Family among the mammals, and as his relatives compete more closely with him for those products which he most desires, than any other class of animals does, he either exterminates them or reduces them to slavery under the name of domestication. There was a time when the Mammoth and the Rhinoceros browsed in Charnwood Forest and came down to the Soar to drink, and the great Cave Lion hunted the Red Deer in the Soar Valley. This was not so very long ago, 50,000 years perhaps. Those mighty mammals were masters of the country till man found his way into it, and the flooding of the Channel cut off communication with the Continent. Then there came a long fight for mastery between the huge quadrupeds and the clever biped, and they gradually disappeared before neolithic man, as the Red Indian disappears before the whites. There still remained, however, among the larger quadrupeds the wolf, the boar, the ox, the sheep, the goat, and the deer, as wild inhabitants of the county, and these held their own until quite modern times, becoming extinct as wild animals only about 500 years ago. The fox is now the largest of our twenty-five or twenty-six Leicestershire mammals. But when the progress of civilisation has put down the barbaric sport of fox-hunting, he also will be rapidly exterminated. As to the smaller mammals, such as the mouse, the rat, and the weasel, they are still able to foil man's efforts to destroy them. Propagating with great rapidity, and concealing themselves in burrows and in the dense vegetable undergrowth which covers the earth like a mat, they still possess the land, to the horror of the gamekeepers and the delight of naturalists.

The accompanying table shows the relation of the British and Leicestershire Mammalian Faunas to that of the whole world. It will be seen that of the eleven modern orders, excluding man, six are represented in Britain, and four in our county at the present time.

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* Transactions of Section D of the Leicester Literary and Philosophical Society. Read January 16th, 1884.

Three species of Insectivora, the mole, the shrew, and the hedgehog, are common everywhere; but it is not popularly known that the shrew, though commonly called a mouse, is not a mouse at all, but is a near relative of the mole. A fourth species, the water shrew, is sometimes found about our brooks and rivers.

Of the three Cheiroptera, the Pipistrelle, or Little Bat, or Flittermouse, is the commonest in this county. The Long-eared Bat and the Noctule or Great High-flying Bat are met with occasionally. I remember some years ago seeing a pair of Noctules flying high above the summit of Beacon Hill one summer evening, their outline and wing-action clearly distinguishing them from any kind of bird.

Of our eleven Rodents, the Hare and the Rabbit would perhaps soon become extinct if they were not protected. The Brown Rat we would extinguish if we could, for it seems to be in civilized regions a pure nuisance. It is not a native of Britain, nor even of Europe. Its original home is Asia, but it has now found its way into every country in the world. It was first seen in England about 150 years ago. At that time we had a Rat of our own—the old Black Rat, a smaller and weaker animal than the brown invader, and now almost extinct. I have heard of its being seen in some old Leicester cellars within the last twenty years.

The Common Mouse is now as widely distributed as the Brown Rat. The Long-tailed Field Mouse is common in many districts. Forty years ago, when I lived at Loughborough, it was our commonest garden pest, and we used as boys to catch it in considerable numbers and to preserve the skins for their beautiful tawny-coloured fur. In my present garden at Birstal Hill it is never seen; we have instead the Short-tailed Field Vole, and a great many Shrews. The Voles are distinguished from the true mice and rats by being purely vegetable feeders, as is shown by their teeth, which are not tubercled on the surface. They are allied to the Beaver. The Water Vole, or Water Rat, is common on the banks of all our rivers and brooks. The Harvest Mouse is, I believe, recorded in the county, but is not common. It is the smallest of the British mammals, and seems most abundant in the Southern Counties, though it is rather a sub-arctic form, and has been found in Scotland. The Dormouse is also rare in Leicestershire. It is a South European form, inhabiting thickets and hedges, and a vegetable feeder, allied to the Squirrel, which is a common animal in this county, and one of the most elegant and interesting of all our Rodents.

Of the Ungulata or Hoofed Animals we have now no wild representatives. The Hog, Goat, Sheep, Ox, Red Deer, Fallow Deer, and Roebuck were all wild or semi-wild 500 years ago, but there is now no room for them here, except as domesticated animals. There were wild Horses in Britain in prehistoric times.

Of the Carnivora we have no wild dog, but there is a wild Cat, which is now extremely rare if not quite extinct in the county. It differs from the domestic cat in being larger, stronger limbed, shorter tailed, flatter headed, and black nosed, although the colour is that of a yellowish tabby. The origin of the domestic cat is not known. It was at one time believed to be descended from an Egyptian species, the Gloved Cat (*Felis maniculata*), but it differs from this in its teeth, though there are resemblances in size and form. Domestic cats which have taken to a wild life are sometimes mistaken for the true Wild Cat.

The Badger is certainly not common in the county, but there are records of its appearance in many localities during the last twenty years. It has long been preserved and protected as a curiosity at the Brand, in Charnwood Forest, and some of those seen about the country may have been escapes from that colony. Otters are still found occasionally on the banks of the Soar; and the Marten, though now extinct, was, no doubt, an inhabitant of Charnwood before the old timber was cleared away 200 years ago.

Of the Weasel, Stoat, and Polecat—the remaining three of our native mammals—the Weasel is still too plentiful for the game preservers; the Stoat is frequently seen, though less abundant; and the Polecat, though the rarest and the largest of the three, is still seen in some retired districts.

EXISTING SPECIES OF MAMMALIA.

Orders.	Leicestershire.	Britain.	The whole World.
1.—Monotremata	0	0	4
2.—Marsupialia	0	0	100
3.—Edentata	0	0	40
4.—Sirenia	0	0	6
5.—Cetacea	0	6	200
6.—Insectivora	4	5	200
7.—Cheiroptera	3	15	100
8.—Rodentia	11	13	900
9.—Ungulata	0	5	400
10.—Carnivora	7	12	400
11.—Quadrumana	0	0	250
	25	56	2600

The known species in most of the Orders are estimated in round numbers. Fifty years ago the estimated total was about 1,200.

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 284.)

In 1870 Klein gave to the world his monograph "Zur Kenntniss des Pilobolus," a monument of patient and minute investigation, such as only a German could produce. In this he describes two species, *P. crystallinus* and *P. microsporus*; under the former name he says that he unites the *P. crystallinus* and *P. œdipus* of former authors. But, though he records his painstaking observations with minute accuracy, in respect of the identification of his specimens Klein was peculiarly unfortunate. His *P. microsporus* is identical with *P. roridus*, and he was unacquainted with either the true *crystallinus* or the true *œdipus*. He had before his eyes, without knowing it, another species hitherto undistinguished, to which Van Tieghem afterwards gave in his honour the name of *Pilobolus Kleinii*. The spores of *œdipus* are yellow, nearly spherical, and surrounded by a thickened epispore; those of *crystallinus* are ellipsoidal and nearly colourless. Now the spores of *P. Kleinii* are also ellipsoidal, but of an orange-yellow colour, and twice as long as those of *crystallinus*; but under certain circumstances it bears sporangia containing nearly spherical spores of the same colour, but without a thickened epispore, and it was this abnormal state, to which I shall, in the fifth part of this essay, give the name of *forma sphærospora*, that led Klein erroneously to imagine that he had met with forms intermediate between *œdipus* and *crystallinus*. Here we have the true mischief-maker, which has been the cause of so many errors. The credit of clearing up this difficulty is due to Van Tieghem, and I am pleased to be able to corroborate his observations by my own. On many occasions I have found the first two or three days' crops of *P. Kleinii* to bear small sporangia, containing roundish spores, of unequal size in the same sporangium. These, however, could be distinguished at once by the want of the thickened epispore from those of *P. œdipus*, and, moreover, the fungus agreed in all respects but its minuteness with the true *Kleinii*, into which it gradually passed on the following days. The inequality of the spores in the same sporangium, together with the dwarfed size, is a guide to the true cause of this abnormal appearance: it points out that the fungus has not yet established itself and is of weak and uncertain growth.

Klein also, as has already been mentioned, believed that he had succeeded in tracing the transformation of Pilobolus into two species of Mucor, and therefore declares his belief in that pleomorphism which various authors have rashly attributed to other species of Mucorini.

In 1871 Cooke published the "Handbook of British Fungi," in which he records[1] two species as inhabitants of Britain, *P. crystallinus* and *P. roridus*. It is impossible from the description of the former to tell what species is intended; the description of the second species agrees with that of *P. roridus*, but not with the figure, which is taken from Currey's plate, in the Journal of the Linnæan Society, already mentioned, and represents, as I have said, *P. Kleinii*. Moreover the note "smaller and slenderer than *P. crystallinus*" is only partially true; *P. roridus* is indeed more delicate, but at the same time taller than *P. crystallinus*, being usually of double height. The same is true if by *P. crystallinus* is meant either *Kleinii* or *œdipus*. There is also a curious error in the generic description of the sporange, which is stated to contain "a globose sporidium."

Brefeld, in 1872, mentions[2] and figures a species which he assigns to the genus Pilobolus, under the name of *P. Mucedo*, but which afterwards[3] (1881) he recognises to be the same as that previously called by Cesati, *P. anomalus*. In the latter place he also gives a short account of the various species of Pilobolus, but, although he describes the species sometimes with great exactitude, yet he is pursued by so strange a fate that not one of the names which he assigns to them is rightly given. His excellent figures, however, enable us to remedy his mistakes. A small table is appended, giving, in the first column, the name assigned by Brefeld; in the second, the true name:

P. crystallinus.	*P. Kleinii*, Van Tieghem.
P. œdipus.	*P. Kleinii*, *forma sphærospora*, mihi.
P. microsporus.	*P. crystallinus*, Tode.
P. roridus.	*P. longipes*, Van Tieghem.

1 Page 633. fig. 301.
2 Botanische Untersuch. i., 27, pl. 1, figs. 25—6.
3 *L.c.*, iv., 66.

It will be seen that Brefeld was unacquainted with the true *œdipus* and the true *roridus*. He was successful, however, in discovering[1] the zygotes of *P. anomalus*.

In 1875 Van Tieghem for the first time[2] cleared up some of the confusion in which the subject had been plunged by previous authors, especially in relation to the *Mucor roridus* of Bolton. Bolton expressly describes his species, which he found in the neighbourhood of Halifax, as "pellucid and white, sustaining a small globular head, like a minute pearly drop, with a black spot on its upper part, which gives to the globe the resemblance of an eye in miniature." No author but Klein had been able, up to this time, to meet with a species nearly resembling this description, and hence it was doubted by some, as by Persoon, Coemans, Greville, and Purton, whether it were really distinct; Klein, as has been said, failed to recognise it in his *microsporus*, and it was reserved for Van Tieghem to describe and figure[3] a form which possibly is that which Bolton had in view, and which is as identical as may be with Klein's *microsporus*. The long, slender stem, the rounded swelling, the minute sporange, and the want of colour of Van Tieghem's species, all point in this direction, and agree pretty well with Bolton's figure. I am inclined to anticipate, however, that the true species of Bolton, if it could be re-discovered, would be found not absolutely identical with Van Tieghem's. In the same memoir Van Tieghem also instituted the new genus Pilaira for the reception of the old *P. anomalus* of Cesati, and added a new species *Pilaira nigrescens*.

In 1878 Van Tieghem completed his work by publishing[4] the descriptions of two new species, *P. longipes* and *P. nanus*, while at the same time he pointed out the error which Klein had made, and bestowed the name of *P. Kleinii* on the species with which he had worked. He also described the chlamydospores of *P. nanus*, a mode of reproduction which had already been signalised by Roze and Cornu[5] (1871) in the case of *P. crystallinus*.

Bainier, in 1882, published his "Etude sur les Mucorinées," in which he describes specimens which he had met with of *P. longipes*, and also a new species *P. exiguus*; he also confirmed Van Tieghem's account of *Pilaira nigrescens*.

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[1] *L.c.*, iv., 65.
[2] Nouv. Rech. sur Muc., pp. 42–51.
[3] *L.c.*, p. 46, pl. 1, figs. 7—13.
[4] Trois. Mém. sur Muc., pp. 24—31, pl. 10, figs. 6—22.
[5] Bull. Soc. Bot., France, xviii., 298.

With reference especially to the Midland district, I may mention that Purton, in his record of *P. urceolatus* [1], which judging from his figure is probably the true *crystallinus*, relates that he found with it some specimens according more or less with the description of *Mucor roridus*, as other authors have done. He, therefore, inclined to the opinion that the latter is only a variety of the former, in which he is supported by Greville [2] and Loudon [3]. Relhan, on the contrary, maintains them as distinct [4], and from his remarks under *M. roridus*—"Capitulo sphærico. Stipes semuncialis, pellucidus, roridus"—seems to have met with a form more closely resembling Bolton's figure than any authors of later date have been successful in doing. I regret much that I have been unable myself to meet with *P. roridus*, which I believe is much rarer than is usually imagined. In the neighbourhood of Birmingham only *P. crystallinus*, *P. Kleinii*, and *P. œdipus* have hitherto occurred.

PART V.—SYSTEMATIC.

Order, MUCORINI, De Bary.
Family, PILOBOLIDÆ, Van Tieghem.

Genus I.—PILOBOLUS, Tode.

1. Pilobolus œdipus, *Montagne*.
2. ——— exiguus, *Bainier*.
3. ——— crystallinus, *Tode*.
4. ——— Kleinii, *Van Tieghem*.
5. ——— longipes, *Van Tieghem*.
6. ——— roridus, *Persoon*.
7. ——— nanus, *Van Tieghem*.

Genus II.—PILAIRA, Van Tieghem.

1. Pilaira Cesatii, *Van Tieghem*.
2. ——— nigrescens, *Van Tieghem*.
3. ——— dimidiata, *mihi*.

[1] Midland Flora, iii., 325, pl. 31.
[2] Flora Edin., p. 448.
[3] Encycl. Pl., p. 1024, fig. 16349.
[4] Flora Cantab., ed. iii., p. 579.

KEY TO THE SPECIES OF PILOBOLUS.

	Swelling ovoid	1
	Swelling globular, or nearly so	6
1.	Spores oval; stem slender	2
	Spores globular; stem relatively short and thick	4
2.	Spores small, less than 10μ long	*crystallinus*
	Spores more than 12μ long	3
3.	Basal reservoir erect or oblique, globular	*Kleinii*
	Basal reservoir creeping, elongated	*longipes*
4.	Epispore thick, conspicuous	*œdipus*
	Epispore thin, not conspicuous	5
5.	Sporange opaque; stem slender	*Kleinii*, f. *sphærospora*
	Sporange transparent	*exiguus*
6.	Sporange narrower than swelling; spores elliptic ..	*roridus*
	Sporange scarcely narrower than swelling; spores globular	*nanus*

The following is an attempt to show the affinities of these species and those of Pilaira:—

longipes   roridus —— nanus
Kleinii —— crystallinus
forma sphærospora   dimidiata
œdipus   nigrescens
exiguus   Cesatii
Mucoridæ

I. PILOBOLUS, Tode.

Stem erect, continuous, separated from the mycelium below by a septum, expanded above when mature. Sporange projected; upper hemisphere with an indurated cuticle, and a diffluent zone below. A thin gelatinous layer between the spores and the columella. Spores roundish or oval, numerous.

1.—PILOBOLUS ŒDIPUS,* Montagne.

Pilobolus œdipus, Montagne, "Mém. Soc. Linn. Lyon," pp. 1-7, f. *a-i* (1828); "Sylloge," p. 299 (1856)—Rabenh., "Fung. Eur.," No. 382—Coemans, "Monogr.," p. 59, pl. 1, f. 1-20 (1861)—Fuckel, "Symb. Myc.," p. 73 (1869); exs. 2204—Van Tieghem, "Nouv. Rech. Muc.," *ex* An. Sc. Nat., p. 43 (1875)—Saccardo, "Michel.," ii., 372, *chlamydospores ex* New Jersey, U.S.A. (1881)—Ellis, No. 3360—Bainier, "Etude," p. 43, pl. 2, f. 1-10 (1882)—Grove, "Journ. Bot.," p. 131, pl. 245, f. 3 (1884).

Pilobolus crystallinus, Cohn, "Entwickelungsgesch.," pl. 51-2 (1851).

Pilobolus reticulatus, Van Tieghem, "Trois. Mém.," p. 25, note (1878).

Hydrophora vexans, Awd. in Collect., *sec.* Fuckel.

Non *P. œdipus*, Klein, *nec* Brefeld.

* Not *Œdipus*, but adjectival, "swoln-footed."

Stem short and thickish; swelling ovoid; basal reservoir roundish, usually above the matrix; spores yellow, spherical, rather unequal, 10·5-14·8μ, with a distinct, thick, bluish epispore.

On horse, cow, goat, and pig dung, and on mud, algæ, and other decaying substances. It seems to be the commonest form on human excrement. Spores germinating easily in water; columella conical, obtuse, sometimes piercing the sporange almost to the summit. Not common. (Figs. 14, 15.)

England, France, Belgium, Germany, America.

2.—PILOBOLUS EXIGUUS, Bainier.

P. exiguus, Bainier, "Etude," p. 47, pl. 2, f. 17 (1882).

Stem rather thick and short; sporange round, black but transparent; spores spherical, yellow, unequal, 14·7-21μ; swelling scarcely developed; basal reservoir concealed roundish.

A small and doubtful species, possibly a form of *P. œdipus*.
France.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER V.—ADAPTATION.

BY WILLIAM L. HIEPE.

Adaptation in its wider sense may be defined as the power of species of animals or plants to vary under altered circumstances, so as to become again harmonised with the environment. In fact, in the power of adaptation we have one of the agencies by which new species are produced. But adaptation of a whole species can only be brought about by adaptation of single individuals during many generations, and it is this adaptation of single individuals or their parts to altered circumstances with which Chapter V. treats principally. In speaking of a single individual adaptation may be described as the power by which in each part of the body the supply of nutritive matter is regulated according to the requirement, and it is, therefore, a necessary concomitant of function. An organism without the power of adaptation would resemble a steam engine which drives several machines, but has no appliances by which to regulate the supply of force to each machine according to the work required to be done by it.

Adaptation being a consequence of function, we may expect to find only very insignificant adaptive changes in plants where function is very limited, and the few examples we find are all confined to parts actually in the process of growth.

With animals it is different. All through the organism a continuous process of decomposition and rebuilding of the tissues is going on; the material of all parts is continually renewed, and thus a certain pliability or modifiability is produced, so that any part even of the adult organism will undergo adaptive changes, although they are produced even more easily during the period of growth. The phenomena of adaptation consist mainly of three general truths, which can easily be verified by our every-day experiences.

The first general truth is that extra function of any organ is followed by extra growth of that organ; muscles unusually exercised grow to an unusual degree, of which the blacksmith's arm and the dancer's leg are examples, as also the thickening of the epidermis on hands which have to do hard or long-continued work. In fact, examples may be found in all parts of the body, and we find similar facts in connection with the nerves, as the increased delicacy of any of our senses on continued practice or when one of them has partly to take the place of the other, as in the case of blind or deaf people.

The second general truth is that after a certain limit is reached, no present, or only very little further, modification can be produced, and that little only very slowly. Athletes very soon reach a limit to the increase of their skill and of their strength, and no possible further exercise will make any difference. Singers in the beginning of their training can increase the compass of their voice a tone or two at each end, but after that no training will increase the range. Very clearly is this second truth recognised in the intellectual faculties. Everyone has a certain capability for drawing, music, mathematics, &c., and everyone can improve this capability, but only to a certain degree or limit, and this limit is different for different individuals, and a special talent for any of these arts or sciences seems to be caused by a special facility of adaptation of the organs which are exercised by them.

The third general truth is that the increase of size by increased function of any organ is not permanent unless the increase of function is permanent. Muscles increased by exercise are soon reduced to the original size when the exercise is not continued, and the rapidity of reduction is proportional to the shortness of the time during which the exercise was continued. If the exercise has lasted for years, it will be a long time before the original size of the organ is restored. In games of skill, as cricket, billiards, chess, and in the playing of musical instruments, we all know that continued practice is necessary to keep up the increased skill gained by it.

In trying to explain all these facts deductively we experience the greatest difficulty in the first of the above three truths. The second and third follow as necessary consequences from the first. That over-exertion of an organ should be met by an extra supply of food is a fact which you would not expect *à priori*. We know from mechanical principles that every action produces an equal reaction, or as Mr. Spencer says, "the rhythmical changes produced by antagonistic organic actions cannot any of them be carried to an excess in one direction without there being an equivalent excess in the opposite direction." But in the phenomena of adaptation we have more than that. The excess in the opposite direction is not only equivalent, but it is more than equivalent, and hence the mean state between the oscillations is altered. A leaden bullet suspended by a string hangs quietly in a vertical line; if drawn out to a certain distance, on being released it will go to the other side to the same distance, come back, and repeat so on. Without friction it would go on for ever, and the mean between the two farthest points is exactly the point at which it was at rest. It would be inexplicable if the pendulum were to go farther on the one side than on the other, and so alter the mean; but what we see in the muscle growing by increased exertion is exactly analogous. But then the processes occurring during the growth of the muscle are not so simple as the processes of an oscillating pendulum. There are primary, secondary, tertiary, &c., processes, and it is by the actions of these that we must try to explain the seemingly contradictory facts. Let us see exactly what occurs when a muscle grows through increased work. Additional work of the muscles necessitates additional supply of blood. This can only be done by additional work being thrown upon the arteries which supply the muscle. The increased supply of blood necessitates increased work given to the veins which carry it off again. And also arteries and veins not in direct communication with the muscle will be similarly influenced. The muscle is excited by the nervous centres, and therefore the nerves will have to carry increased nervous force to the muscle, and this increased nervous force and extra supply of blood will produce an increase of the power of assimilation, which again results in the increase of the size of the muscle.

To explain the second truth—that in the increase of size a limit is soon reached—we have only to follow a little farther the processes explained above. It was found that the immediate arteries and veins had increased work to do. To perform this for any length of time they must grow, *i.e.*, increase in diameter and contractile power. The growth of these arteries results in growth of others which supply them, and so on. All the other organs are similarly affected. It is like a wave of increased growth passing through the whole of the body, affecting the remotest parts last. We find, therefore, that an organ will grow rapidly as long as it does not cause any considerable alterations in other organs; but when this point is reached further growth can take place only very slowly, as it depends on the remodelling of numerous parts only slightly and remotely affected.

But we find in this also an explanation of the fact that in growing individuals adaptive changes take place more easily than in adults. In an adult animal assimilation and expenditure have reached a balance, so that increased nutrition of one part implies decreased nutrition of some other part; in other words, besides a considerable amount of building up there must be an equivalent amount of unbuilding of less important parts. But in the young and growing animal there is always excess of assimilation over expenditure, and this excess can be utilised on the necessity of increased nutrition arising in one part through increased function without unbuilding becoming necessary. We may compare an adult organism to a person who just uses all his income for his customary expenses. When occasion arises to increase expenses in a certain direction it can only be done by decreasing them in another, and if increased expenditure in one direction becomes permanent a complete rearrangement of expenses would become necessary. But the young and growing animal resembles a person who earns more than he spends, and an increased expense in any direction can be met by the surplus without interfering with the other items.

In the consideration of the above processes we find also an explanation of the third truth, that after the excess of function has ceased the original state is reached again after a longer or shorter time. The modifications which have to occur in the remotest parts of an organism on continued excess of function of one organ can take place only exceedingly slowly, and while these modifications are going on the part that was modified most recently is not in equilibrium with the rest, namely, those which are not yet modified. Should the increase of function be carried on till every part, every cell, one might almost say, has undergone the required amount of change and a new and perfect equilibrium is established, then the change would be a permanent one. But the time required for this is more than the lifetime of one generation. If the increase of function ceases before the new equilibrium has been established, then the last affected parts are changed only very slightly, and are not in equilibrium with the rest; they, therefore, resume their former state in a short time. The parts that depend on them immediately will do the same, and so the process of restoration of the former state goes on the reverse way, till at last the originally affected organ is again reduced to its former size. It is easy to understand that the longer the increase of function in that organ lasted, or, in other words, the farther these adaptive changes have proceeded towards the remoter parts of the body, the longer time will be required in regaining the original state.

Mr. Spencer illustrates the whole of the process of adaptation by an analogy from commercial processes. He assumes a suddenly increased demand for iron ships, this causes an increase in the demand for iron, this again affects the demand for coal, &c., and he shows that in every detail the process is exactly analogous to the process of an organ growing by increased exertion, and also that the restoration of the original state takes place in both cases in an exactly analogous way.

EXPOSITION OF CHAPTER VI.—INDIVIDUALITY.

Chapter VI. treats of individuality, and nearly the whole of it is devoted to the solution of the question: What constitutes an individual? One might think that was a task which would hardly require a whole chapter, but Mr. Spencer shows that it is not only a very difficult matter, but that it is impossible to give a perfectly satisfactory definition of an individual. The case is clear enough as long as we consider only the higher animals, but when we extend the word Individual to the whole organic world, an exact definition of its meaning becomes a matter of great difficulty.

To begin with plants, although it is a rule to speak of a tree or any whole plant as singular, we must not forget that every branch and every bud has to a certain extent an independent life. If cut off and planted it will make roots, grow, and become a whole plant like the one it was derived from. Are we to consider both as parts of one individual or as two separate ones? and, in the latter case, when exactly does the separate individuality of the cut-off branch begin? In the case of plants which send out runners, which make roots and grow into separate plants, we have the same questions to answer.

In the animal kingdom we find still greater difficulties. All the numerous cases of compound Hydrozoa present us with almost an exact analogy to the tree just spoken of. We find young perfect animals budding out from the parent animal, but remaining in permanent connection with it. Are we then to consider each polype as an invividual, or are we to give that signification only to the whole colony? The difficulty increases when we find that in many cases the individuality of each member becomes partially merged in the individuality of the colony. We find, in fact, an association on the principle of division of labour, some members attending to the locomotion, some to the procuring of food, some to digestion, some to reproduction, &c. Probably in these cases we are witnessing one of the steps by which Nature proceeds in the creation of new organisms of a higher development and differentiation. We may suppose this merging of the single individuality into the aggregate individuality, and the application of the division of labour, or rather of function, to go on increasing, and thus we have the material out of which to construct a being of almost any amount of organisation and differentiation. Have we not in the articulate animals a structure which might have been brought about by a similar process?

As a definition of an individual it has been proposed to give that name to the whole product of one single fertilised germ; but there are many difficulties and much inconvenience attendant on that course. It is a clear and satisfactory definition in all cases where one fertilised germ produces only one separate perfect animal. But there are cases such as the Medusæ, and the Aphides, where one germ gives rise to a multitude of perfect animals. Are we then to consider all these animals as parts of one individual? The proposition to call an individual each perfect animal which has the power to reproduce its kind is met by similar difficulties, in the case of bees, ants, &c., where we find perfect and separate animals unable to do so. If they are not individuals, what are they? and what are we to do in the case of insects where the animal attains the power of reproduction only in the mature stage? Thus we are forced to the conclusion that no perfect definition is possible, and that the best course is to make a compromise. We must consider that with the idea of an individual is always associated the idea of a complete whole, a concrete and not a discrete whole, and also the manifestation of independent life. We will then define as an individual any concrete whole manifesting life, or any concrete whole having a structure which enables it, when placed in appropriate conditions, to continually adjust its internal relations to external relations, so as to maintain the equilibrium of its functions. Thus we have to consider as individuals all buds and shoots of plants, each aphis, each single polype, &c.

ON "THE ZYGNEMACEÆ: A CHAPTER IN THE HISTORY OF THE FRESH-WATER ALGÆ."*

BY MR. F. BATES.

The *Zygnemaceæ*, an important and interesting family of fresh-water algæ, occur in ponds, ditches, &c., as floating or partially submerged, unattached masses of a pale to a dark grassy-green colour, and are slimy to the touch. In their younger and sterile condition they are amongst the most beautiful of all the fresh-water algæ, when viewed under the microscope in a freshly gathered state. Unfortunately they suffer considerable deterioration some time after being mounted as microscopic objects, as no trustworthy medium has yet been discovered which will preserve them in their pristine beauty, a certain shrinking, with loss of brightness and colour in the chlorophyll bodies, always ensuing. The masses consist of delicate, long threads or filaments, composed of rows of cylindrical cells. A marked feature in the larger and more robust species is the *cytoblast* or *nucleus*, which is suspended in the sap-cavity of the cell by means of delicate threads of protoplasm, radiating from it to the chlorophyll bodies; but it is these latter which most attract attention by the beauty of their form, arrangement, and colouring. These bodies in *Zygnema* take a radiate, or stellate, form, a pair in each cell; in *Spirogyra* they consist of longitudinal rows of parietal bands, arranged spirally; in *Mesocarpus* and others, of axile plates or bands.

Agamogenesis, or vegetative increase, is effected in these plants by repeated transverse cell-division or bi-partition, with subsequent growth of each moiety to the dimensions of the original cell.

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read April 23rd, 1884.

This is a form of the *interstitial* mode of growth. A full description of this process, as well as of the more complicated process of nuclear division, or *karyokinesis*, will be found in Sachs' "*Text book*," last edition (1882), pp. 16-18. Whoever desires, however, to observe this phenomenon for himself must needs rise early, for it is a remarkable fact in the history of these plants that this process—as well as most other of the higher vital phenomena, or those concerned in reproduction—takes place in the early dawn. I cannot here do better than give Sachs' explanation for this curious fact. "An obvious and necessary condition of these processes of growth, whether in the dark or the light, is the presence of the supply of assimilated reserve-materials, at the expense of which the formation of new cells can take place. In the case of the buds of the higher plants their reservoirs of reserve-materials are the bulbs, tubers, rhizomes, parts of the stem, cotyledons, and endosperm; after the complete exhaustion of these, growth ceases in the dark but continues in the light, because the assimilating organs can then produce new material. This relation of growth which is connected with cell-division to assimilation is especially clear in algæ of simple structure (as *Spirogyra*, etc.), which assimilate in the daytime under the influence of light, while cell-division proceeds exclusively, or at least chiefly, at night. The *swarm-spores* are also formed in the night, but swarm only with access of daylight. While, therefore, in the larger and more highly organised plants assimilation and the construction of new cells out of the assimilated substances is carried on in different parts but at the same time, in small transparent plants in which the parts where these functions are effected are not surrounded by opaque envelopes they take place at different times. We have here a case of division of physiological labour, which shows us that the cells which have to do with chemical work (assimilation) cannot at the same time perform the mechanical labour of cell-division; the two kinds of labour are distributed in the higher plants in space, in very simple plants in time." ("Text book," edition 1882, pp. 752-3.)

It seems highly probable that there is a specific limit to the power of extension by cell-division, and that when this is reached there comes into play that far more important operation which leads to the production of a new generation by the formation of a *spore*. And this conclusion would be quite in accordance with analogy, as a flowering plant usually only produces seed when the vigour of its vegetative growth is waning.

Gamogenesis, or sexual reproduction, finds its simplest expression in this humble family of plants. Ordinarily the sperm and germ-cells are widely distinguishable; but here no real or perceptible differences of any importance are discernible, the two sexual elements being apparently still undifferentiated masses of protoplasm. It is true there are observers who believe they have discovered some slight differences in the two cells. Professor Bennett, in a recent communication to the Linnæan Society, affirms that there is an appreciable difference of length and diameter, the germ-cell being the larger; also that their protoplasmic contents pass in one direction only. The first of these statements I might be prepared to accept, as it is analogous to what obtains in the diœcious species of *Œdogonium*; but the fact that in many species of the *Zygnemaceæ* the contents of *both* cells pass into, meet, and coalesce in the middle of the conjugating canal, seems to me fatal to the second statement. However, this is a point which must be left to future investigation; still it must not be supposed that I absolutely deny that differences may exist; on the contrary, I believe that they *must*, but the question is at present involved in obscurity.

Conjugation, as the union of the two sexual elements is called in these plants, is effected in various ways, but the principle is the same in all. At the proper season for the species, whether the spring, summer, or autumn, filaments lying side by side put out from the opposing face of each cell a protuberance of the cell-wall. This goes on increasing until the two ends meet. When their opposing faces come in contact, fusion, with absorption of the intervening membranes at the point of contact, takes place; there is consequently formed a tube or channel of communication from the one cell to the other. Whilst this has been going on certain changes have been taking place in the contents of the cells. The protoplasm lining the cell-walls becomes detached and collapses on the central mass. Some observers declare that this always commences first in the sperm-cell, or that whose contents pass over to the other or germ-cell. However this may be, contraction, with expulsion of the water of the cell-sap (Sachs), takes place, and the entire contents of the one cell pass over, by means of the channel of communication described, into the other,* with whose contents it completely coalesces, the two nuclei even becoming fused together. As Sachs observes ("Text Book," 1882, p, 9), "the coalescence gives the impression of the union of two drops of fluid, but

* Except in those cases where conjugation takes place in the conjugating canal.

the protoplasm is never fluid in the physical sense of the word." When complete union of the two cell masses, accompanied by further contraction and expulsion of water (Sachs), has taken place, the united body assumes its specific form and begins to elaborate its protective envelope. This is composed of three layers, the innermost of which only—being the true spore membrane—is concerned in the after germination of the spore; the other two forming a merely protective shell. When all is perfected, this body—the result of the union of the contents of two cells—is termed a *Zygospore*. This is the equivalent of the seed in the higher plants: like the seed, the zygospore has enduring vital power; it can survive the lapse of time, extremes of temperature, and so forth. As this body matures its contents become brown, homogeneous, and refractive; a conversion of its endochrome into oily matter apparently takes place. When germination begins the oily matter disappears or is reconverted into green granular matter; this soon assumes a spiral form which becomes more distinguishable with the lengthening of the cell.

After some months of rest—and in its proper time, the conditions being favourable—the zygospore begins to germinate. The inner and stouter of the two layers of its protective shell, or envelope, dehisces by a longitudinal sinuous fissure in all those having an ovoid form; the young plant—the future filament—then bursts through the outer layer and emerges as an elongate claviform body attached by its thin end to its envelope. It grows rapidly, cell division commences, and soon it assumes the form of, and ultimately grows into a free filament like those from which it sprang. With the germination of the zygospore the life cycle is completed; the empty shell—together with its parent cells—having fulfilled its office, now speedily decays. It does not always follow that the zygospore is formed in the germ-cell. In some species of *Zygnema*, in *Mougeotia*, and in *Mesocarpus*, it is formed in the middle of the conjugating canal; whilst in *Staurospermum* it is a cruciate, or a four or more angled body, occupying the whole of that space.

The three typical *forms* of conjugation in this family are: the *scalariform*, the *lateral*, and the *genuflexuous*. In the first the entire series of cells of each of two parallel filaments usually take part in the process; there results a ladder-like body, the two filaments representing the side pieces, and the transverse conjugating canals the rounds. This is the most common form, and here the zygospore is always formed in the germ-cell.

In the second, or lateral form, also called the *Rhynchonema* form, conjugation takes place between cells of the *same* filament, and is effected as follows:—At the point of junction of two cells—that is, at the septum, a beak-like swelling, or bulging out on one side of the cell walls, takes place; this forms a passage of communication between two adjacent cells round by one end of the septum; by this passage the contents of the one cell pass over to the contents of the other and coalesce with them in the usual manner, forming a zygospore. It not unfrequently happens that both this and the scalariform method take place simultaneously in one and the same species. I have often met with examples of *Spirogyra insignis* and *Weberi* having the *same* threads showing scalariform conjugation in part of their length, and lateral in the remainder. A variety of this (lateral) form of conjugation is not unfrequent in some species of *Spirogyra*. It consists in two cells, not in immediate proximity, each putting forth at right angles to the axis of the cell a side protrusion of the cell-wall; these, becoming bent, grow towards each other, parallel with the filament, and when they meet the consequences already detailed ensue. It sometimes happens, however, that the attempt to unite is abortive, the cells being too widely removed to permit the connection of their outgrowths before the developmental limit of these is reached. These cells are consequently doomed to single blessedness, but some sort of compensation is provided for such cases as we shall presently see.

In the third, or *genuflexuous*, form of conjugation, the cells here and there of opposing filaments bend towards each other in a knee-like manner until they come in contact; absorption of the cell-walls then takes place at the point of contact, permitting the passage of the contents of the one cell into the other where coalescence takes place in the usual manner, the resulting zygospore being formed in a bulged-out portion of the cell-wall at one side. It would appear that this process is but rarely performed in its entirety, at least in *Mesocarpus pleurocarpus* (= Mougeotia genuflexa). This is a most abundant and widely distributed plant, occurring in masses in canals, ponds, ditches, and even in the watering troughs for horses; yet, although I have met with it profusely in the geniculate condition, I have never seen it in true conjugation, or met with its spore. This being so it is difficult to account for its abundance and wide distribution. I have remarked, however, that the threads of this plant have a great tendency to break up into their component cells; whether this may, in some obscure manner, compensate for the lack of spores seems problematical, as it is opposed to the modern conception that without a gamogenetic act the permanence, within certain limits, of a species cannot be maintained; and that mere vegetative growth or increase must ultimately result in its extinction. Indeed the modern belief that gamogenesis takes place at *some* period in the life-history of all species of plants, however humble, is constantly receiving the sanction of experience.

The student of the Fresh-water Algæ will be a continual witness to their recuperative power. He will constantly see how nature foiled in one process instantly initiates another in the endeavour to restore the balance. Let him betake himself to the nearest pond or ditch and make a gathering of vigorously growing *Vaucheria*; then slightly rupturing a cell-wall, let him place the plant in water under his microscope and watch what ensues. He will see portions of the protoplasmic contents of the ruptured cell flowing out in an apparently oily stream, but as soon as they come in contact with the watery medium breaking up and contracting into spherical and other masses which immediately throw around themselves a protective skin, or envelope; in other words, he has witnessed the formation of gonidia-like bodies presumably possessing the power to germinate, and ultimately to grow into plants like that from which they emanated. The portions of the protoplasm left in the cell also contract into globular masses which acquire apparently a cellulose coat. Hanstein has also observed that if a filament of *Vaucheria* becomes injured, the protoplasm of the injured part immediately contracts and protects itself by a septum which shuts it off from the injured part.

Certain somewhat analogous proceedings frequently take place in those cells of the *Zygnemaceæ* which fail to perform their function; the loss of the normal act being apparently partially compensated by the formation of other bodies, presumably capable of reproducing the likeness of the parent plant, out of the contents of the cells.

Reproduction in the Fresh-water Algæ by means of zoögonidia is nature's mode of providing for the dissemination of a species. This form of increase does not, it seems, normally occur in the *Zygnemaceæ*: but, as I have just observed, in cells not conjugating, or otherwise failing to perform their function, certain apparently abnormal proceedings take place. These are the differentiation of the plasma of the cell into certain rounded bodies which become encysted, thus simulating a resting form of zoöspore; or numbers of nearly colourless zoögonidia are formed out of the cell contents. On one occasion I witnessed the emission of these latter from an accidentally ruptured cell: their motion was very feeble and not at all like to the same bodies normally produced in other algæ.

There is no more deeply moving and exciting spectacle in the whole range of natural phenomena than is afforded in witnessing the emission from the mother cell of normally produced zoögonidia, as it occurs in the genus *Ulothrix*. You perceive that the cells of certain filaments are densely packed with green ovoid granules, in place of the usual quadrangular plate of endochrome: you are gazing upon these apparently inert masses of matter, when lo! in an instant, and without premonitory symptom, the entire mass of granules in a cell is in motion, and a portion is seen protruding through the cell-wall; in a short space, and by successive efforts, the entire mass passes out of the cell, which closes with a rebound. It is then seen that these bodies are enclosed in a filmy envelope of bubble-like tenuity. After a brief period of repose, the outer members of the group begin to jerk and tug and oscillate, and soon separate themselves from their fellows; the remainder speedily follow, and you have before you a group of from 8 to 32 or more biciliated subpyriform bodies all in a state of wild activity. Cell after cell rapidly discharges its contents till you behold a mass of bodies madly gyrating and waltzing round each other as if, by this, giving expression to their sense of this new active and exuberant life. On viewing the empty cell there is no apparent rupturing of its wall; it is, therefore, presumable that the escape of the body of micro-zoögonida is effected through an orifice specially formed in the cell-wall at the precise period required for its emission: and this is precisely analogous to what takes place at the period of the fertilization of the oöspheres in *Vaucheria* and *Œdogonium*.

Pre-eminent among the many questions of importance at present engaging the attention of vegetable physiologists are the nature of the relations that exist between the cell-wall and the protoplasm, and the possible continuity of the protoplasm through the walls of cells. Until recently the cell-wall has been regarded as a sort of protective envelope, elaborated by the protoplasm body, and in which it, in a manner, imprisoned itself and cut itself off from contact or connection with the protoplasm of neighbouring cells, a wall which acts, as Professor Hillhouse has said, towards the individual cell as an exoskeleton. Facts are now rapidly accumulating which will no doubt ultimately lead to an abandonment of that conception. As Hillhouse observes, "in modern teaching the vegetable organism is a *whole*, with its protoplasmic body, it is true, broken into fragments which show apparent isolation but which, nevertheless, show clear co-ordination." Further, "the anatomical isolation which has been ascribed to the vegetable cell is also shown to be but a partial truth, if, indeed, it be a truth at all."

Hillhouse, Hick, Gardiner, Massee (whose observations have been confirmed by Professor Bennett), Groves, and others have all arrived at the conclusion that these intercellular relations, by means of delicate connecting threads of protoplasm, do exist, but differ somewhat as to how they are effected, whether by open pits in the cell-wall or not.

I need scarcely point out the important bearings of this discovery, for it will at once be evident how potent a factor it must prove in accounting for many curious facts that have hitherto puzzled the vegetable physiologist. As Gardiner has said: "Observations now and lately recorded give us the power of a clearer insight into such phenomena as the downward movement of a sensitive leaf upon stimulation; of the wonderful action of a germinating embryo on the endosperm cells, even to those which are most remote from it; of the action of a tendril towards its support, and of various other phenomena in connection with general cell-mechanism." Mr. F. O. Bower has also contributed an important paper "On *Plasmolysis* and its bearing upon the relations between cell-wall and protoplasm." The conclusion he arrives at seems to be at conflict with that reached by the other observers mentioned. His explanation for the presence of the delicate threads of protoplasm that are still left connecting the main mass (which has been contracted from the cell-walls by means of a solution of common salt used as a plasmolysing agent) with the cell-wall appears to be, that the peripheral part of the mass of protoplasm in the cell is here and there entangled, as a net-work, among the deposited microsomata, and may, therefore, on the contraction of the main mass, be drawn out at the points of entanglement into fine threads. Whether by this he simply means that there is a more intimate connection between the cell-wall and the protoplasm than has hitherto been suspected (in which case he would be in accord with other investigators); or means to imply there is a continually intimate connection—even if not indissoluble bond of union—between the cell-wall and the protoplasm, I cannot say, but I should imagine not the latter: for such a conclusion would be so manifestly at variance with many well ascertained facts. For how, on that view, are we to account for the phenomenon of conjugation, for the formation of oöspheres, for all acts of rejuvenescence of the cell, and so forth? It is clear that in all these cases the *entire* mass of protoplasm parts from the cell-walls and, in many cases, passes entirely out of the cell, leaving it to decay, which it speedily does. Besides this the conception fails to account for the many curious facts in vegetable life already mentioned. The conclusions arrived at by all the mentioned observers are based upon investigations conducted by means of certain micro-chemical and staining reagents, and this brings me to the point of these remarks.

Would it be possible to detect these delicate threads of protoplasm and to trace their connections without the use of reagents? If this be possible, then we have in the *Zygnemaceæ* the fittest material to work upon in the endeavour to elucidate these questions. For in the phenomenon of conjugation we have *Nature herself* acting as the plasmolysing agent, dissolving the bond of union between the cell-wall and the protoplasm. I have no practical or experimental knowledge to impart on these points; but the attempt to solve them in the manner here indicated is well worth an effort; and I here invite the younger and more vigorous of the botanical members of this section to devote a few all-night sittings to the observation of the phenomenon of conjugation with a view to contribute something towards a solution of these vexed questions.

Rabenhorst, in his "Flora Europæa Algarum," enumerates 125 species of *Zygnemaceæ*, distributed in ten genera. Dr. Cooke, in his "British Fresh-water Algæ," has subjected many of Rabenhorst's species to a much needed revision, and has considerably reduced their number; he describes thirty-seven species as occurring in Britain, distributed in eight genera. I myself have collected thirteen species determined—with two or three others not yet met with in fruit—in the immediate neighbourhood of Narborough, including one that was new to the British list.

In concluding I would strongly urge upon this Section how much it is to be desired that some of its botanical members forsake the more beaten paths of their pursuit, and seek "fresh fields and pastures new" in the study of the Fresh-water Algæ. I can promise them a most exciting and interesting task. The field is large and there is room for many workers. Very much yet remains to be done: in fact, it might almost be said that the study of these plants has scarcely yet advanced beyond the incipient stage. Observation and research are constantly proving that many so-called species, and even genera, are but stages in the life history of other species; and it is extremely probable that future research will place the bulk of the considered genera and species of the families *Palmellaceæ* and *Chroöcoccaceæ* in the same position. So here is store of work before you: a wide field for profitable labour and original research; for it is the Fresh-water Algæ that give the most emphatic sanction to the assertion that "The study of the entire life-history is the only means towards the solution of the value of species."

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(Continued from page 293.)

JUNCACEÆ.

LUZULA.

L. vernalis, *DC.* (*L. pilosa*, Willd). *Broad-leaved Hairy Woodrush.*
Native: In woods and on shady banks. Locally common. April, May.
I. Sutton Park; Trickley Coppice and New Park, Middleton; Hoare Park, Over Whitacre; Kingsbury Wood; Bentley Park; Hardings Wood, near Maxstoke; Arley Wood; woods near Solihull; Chalcot Wood, Umberslade; Clow's Wood, near Earl's Wood.
II. Frankton! and Prince Thorpe Wood! *R.S.R.*, 1877. Combe Woods; Waverley Wood, Stoneleigh; Oakley Wood; Chesterton Wood; woods, Walton Village; Alveston Pastures; Oversley Wood; Austey Wood, Wootton Wawen; Bush Wood, Lapworth; Haywoods.

L. maxima, *DC.* (*L. sylvatica*, Gaud). *Great Woodrush.*
Native: In woods. Local. May, June.
I. Arley Wood; Bentley Park; Hartshill Hayes; woods near Oldbury; Boultbie Wood, near Meriden.
II. Combe Woods; Haywoods; Oversley Wood, &c.

L. campestris, *DC.* *Field Woodrush.*
Native: In pastures, on heaths, heathy roadsides and banks. Common. April, May. Area general.

L. erecta, *Desv.* (*L. multiflora*; *L. congesta*, *Lej*). *Many-headed Field Woodrush.*
Native: In peaty bogs, damp heath lands, and heathy waysides. Local. June to August.
I. Sutton Park; Trickley Coppice and New Park, Middleton; Coleshill, bog and heath; Hill Bickenhill; Kingsbury Wood; Baxterley Common; Earl's Wood.
II. (*Juncus liniger*) On the road from Coughton to Sambourne, *Purt.* i, 179. Arbury Woods! Brandon Woods! *Kirk*, *Phyt.* ii, 971. Haywood! *Y.* and *B.* Combe Wood; Oakley Wood.

The variety *congesta* has the same range as the type, the two plants usually growing together.

JUNCUS.

J. conglomeratus, *Linn.* *Common Rush.*
Native: In bogs, marshes, marshy heath land and near pools. Common. June, July. Area general.

J. effusus, *Linn.* *Soft Rush.*
Native: In marshes, bogs, damp heath land, and near pools. June, July. Common. Area general.

J. diffusus, *Hoppe.*
Native: Near pools and on damp heath lands. Rare. July.
I. Balsall Street, *Herb. Perry.* Near Curdworth Bridge. Bannersley Rough.
II. Pit near Honiley Church! *H.B. Herb. Brit. Mus.* Canal near Rugby Wharfe, *Rev. A. Blox.*, *R. S. R.*, 1868. Cathiron Lane.
Sir J. D. Hooker considers this to be a hybrid between *glaucus* and *effusus*. Student's Flora (ed. 3), 414.

J. glaucus, *Sibth.* *Hard Rush.*
Native: In marshy places, near pools, and on heathy roadsides. Common. June, July. Area general.

J. obtusiflorus, *Ehrh.* *Obtuse-flowered Rush.*
Native: In wet boggy places, and near canals. Rather rare. July.
II. In some boggy ground near Bidford Grange; in a stream at Broome, *Purt.* i, 177. Canal near Wyken. Near Binton, *T.K.*, *Herb. Perry.* Oxtail Farm, near Stratford-on-Avon, *W.C.*, *Herb. Perry.* Woodloes! *Y. and B.* Chesterton Moat, *H.B.* Itchington Holt; in abundance, small pool near Birdington Wharf, 1883; on the side of the canal near Bearley Aqueduct; and in abundance near Crab Mill, Preston Bagot.

J. acutiflorus, *Ehrh.* *Sharp-flowered Rush.*
Native: In bogs, marshes, near pools, and on damp road sides. Common. July, August. Area general.

J. lamprocarpus, *Ehrh.* *Shining-fruited Rush.*
Native: In marshes and damp sandy places. Locally common. July, August.
I. Sutton Park; Middleton Heath; Bannersley Pool; stone quarries, Hartshill; sand quarry, near Stonebridge; sand quarry, Cornels End; Bentley Heath, &c.
II. Myton, *Y. and B.;* near Newbold, *R.S. R.*, 1877; Chadshunt, *Bolton King;* Lye Green; Lapworth; Binley Common; old quarry, near Newbold-upon-Avon.

J. supinus, *Moench.* *Lesser Jointed Rush.*
Native: In boggy and marshy places. Local. June to August.
I. (*Juncus uliginosus*), Coleshill Pool! *Purt.* i, 177.; Sutton Park, very abundant; Middleton Heath; stone quarries, Hartshill; near Atherstone Outwoods; sand quarry, Cornels End; Bannersley Rough; Baddesley Common; Forshaw Heath.
II. Beausale Common, *Y. and B.;* Binley Common.

J. bufonius, *Linn.* *Toad Rush.*
Native: On damp road sides, damp drives in woods, and in drains, &c. Very common. July, August. Area general.
Var. *b. fasciculatus*, Bert. Rare.
I. Sutton Park, *W. B. Grove.* Sandy roadsides near Coleshill.
II. Yarningale Common; Lye Green.
The varietal characters are scarcely constant in this variety as in the one tuft I find branches with the flowers two or three in a cluster and other branches with the flowers solitary as in the type. It is, however, always a much dwarfed plant.

J. Gerardi, *Lois.* *Round-fruited Rush.*
Native: Near rivers, and in brackish marshes. Rare. June.
II. Near Stratford-on-Avon Church, *W.C.*, *Herb. Perry.* Chesterton; Southam Holt, *H.B.!* Beside Napton Reservoir, *H. W. Trott!* *R.S.R.*, 1878. In a meadow by the Stour a little below Tredington, *F. Townsend.* Near St. Dennis, *Newb.* Arrow Lane, near Alcester.

I have seen specimens from two of these localities besides the last, and these appear to be undoubtedly *J. Gerardi*.

J. squarrosus, *Linn.* *Heath Rush.*
Native: On heaths and heathy roadsides. Local. June, July.
I. Coleshill Heath! *Purt.* i, 176. Sutton Park; Marston Green; sand quarry, Cornels End.
II. Haseley, *Y. and B.*

CYPERACEÆ.

SCHŒNUS.

S. nigricans, *Linn.* *Black Schœnus.*
Native: In bogs and boggy meadows. Very rare. July.
I. Boggy meadows by the Tame under Dosthill, near Middleton. *Ray. Cat.*, ed. 3, 1677. Coleshill Bog, *Purt.* i, 163.

I have searched both these localities, but have not been able to find this plant in either.

CLADIUM.

C. Mariscus, *Brown.* *Fen Sedge.*
Native? by rivers. Very rare. July, August.
I. By the River Tame, near Tamworth *Ray. Syn.*, ed. 3, p. 426. River Tame, below Coleshill. *J. Power, M.S. Note in B.G.*

I have never been able to find this plant in the county. Possibly extinct now.

RHYNCHOSPORA.

R. alba, *Vahl.* *White Beaked Sedge.*
Native: In turfy bogs. Very rare. July, August.
I. Near Packington! *Aylesford, B.G.*, 633. Coleshill Bog. *Purt.*, i, 62. Marshy Coppice, Hill Bickenhill.

HELEOCHARIS.

H. acicularis, *Linn.* *Slender Club-rush.*
Native: In turfy bogs, and by pools and canals. Rare. July.
I. Sutton, *Freeman, Phyt.* i, 262; Oldbury Reservoir; Olton Reservoir; Coleshill Pool; canal side, near Catherine-de-Barnes Heath; Earl's Wood Reservoir.
II. In waters, near Arbury Hall; Stoke Heath, *Kirk, Phyt.* ii, 971; Seas Wood Pool, *T. K., Herb. Perry*; canal side (abundantly), near Stratford-on-Avon; Canal Reservoir, near Kingswood; canal side, near Bascote Lodge, on the way for Radford Semele.

H. palustris, *Linn.* *Marsh Club-rush.*
Native: In marshes, pools, ditches, and streams. Common. May to July. Area general.

H. multicaulis, *Sm.* *Many-stemmed Club-rush.*
Native: In spongy bogs. Very rare. June, July.
I. In a marshy coppice, near Packington
II. Near Harboro-Magna. *Rev. A. Blox, R. S. R.*, 1871.

SCIRPUS.

S. pauciflorus, *Lightf.* *Chocolate-headed Club-rush.*
Native: In marshes and turfy bogs. Very rare. July.
I. Sutton Park, in several of the marshes and boggy places.

S. cæspitosus, *Linn.* *Scaly-stemmed Club-rush.*
Native: In bogs and damp heathy roadsides. Rare. May, June.
I. Middleton, *Ray. Syn.*, ii, 429; Sutton Common, *Luxford, Herb. Brit. Mus.*, May 23, 1835; Coleshill Bog, *T. K., Herb. Perry!* Botany Nook, Sutton Park, *J. P., M.S. note B. G.*

This plant appears to be extinct now in Sutton Park; the specimen in Perry's Herbarium is correct.

S. fluitans, *Linn.* *Floating Club-rush.*
Native: In pools and marshes. Rare. June to August.
I. Marshy coppice, near Packington; small marsh on Coleshill Heath; Bracebridge Pool, Sutton Park.
II. Haseley, *Herb. Perry.*

S. setaceus, *Linn.* *Bristle-like Club-rush.*
Native: In wet sandy ground, damp pastures, and road sides. Very local. June to August.
I. Polesworth Common, *J. P., M.S. note, B. G.;* damp pastures at Tyburn, *F. Terry!* Sutton Park; Middleton Heath; heath lands, near Atherstone Outwoods; stone quarries, Hartshill; Olton Pool; Olton Reservoir; lane from Four Ashes to Box Trees, Hockley; Forshaw Heath.
II. Arbury Park, *T. K., Herb. Perry;* Blue Boar Lane, near Rugby, *R. S. R.*, 1878; Honington, *Newb.;* Itchington Holt! *Y. and B.;* Yarningal Common.

S. lacustris, *Linn.* *Bull-rush. Tall Club-rush.*
Native: In rivers, ditches, and pools. Locally abundant. July, August.
I. Canal at Tyburn, *F. Terry!* Sutton Park; canals about Atherstone; Rivers Tame and Anker, near Tamworth; Rivers Cole and Blythe, near Coleshill; near Solihull; Bradnock's Marsh; Temple Balsall.
II. Whitmore Park, *T. K., Herb. Perry.* Chesterton Pool! *Y. and B.*, Honington; Tredington, *Newb.*, Binton Bridges; Bidford; Oversley; canals near Bearley, Hatton, and Rowington; River Avon, near Brandon; near Brinklow; frequent in the Avon, near Rugby; in the Itchin, near Bascote Lodge.

S. Tabernæmontani, *Gmel.* *Glaucous Bull-rush.*
Native: In brackish marshes. Very rare. June to August.
II. Southam Holt, *H.B.!* Itchington Holt.
This plant is becoming very rare in these localities, owing to drainage.

S. maritimus, *Linn.* *Sea Club-rush.*
Native: In brackish marshes. Very rare. July.
II. Salt Marsh, Southam Holt, *H.B.!* In abundance in a cattle pool near Flecknoe House, near Rugby.

S. sylvaticus, *Linn.* *Wood Club-rush.*
Native: In marshes, near pools, river sides, and in woods. Local, but widely spread. June, July.
I. In many places by the Tameside near Tamworth! *Ray, Syn.*, 426, 1724. Edgbaston Pool, *With.*, ed. 7, 104. Merivale! *J.P.*, *M.S. note, B.G.* Sutton Park; Spring Pools, Kenwalsey; marsh by Olton Pool; lanes near Olton Railway Station; Blythe Bridge, near Solihull; Henfield; Temple Balsall; near Knowle Railway Station; Bradnock's Marsh; near Packwood; Spring Coppice, near Hockley.
II. Oversley Mill pool! King's Coughton; *Purt.* i, 64; Myton, Emscote, Harborough, *Y. and B.* In the river near Avon Mill; and in the Swift near Rugby Canal, *R. S. R.*, 1877. Combe Woods, 1875; near Rowington; on the side of a drain near Henley-in-Arden. Near Claverdon; Spinney, near Farnborough; Binton Bridges.

(To be continued.)

METEOROLOGICAL NOTES.—September, 1884.

The barometer was rather low (29·591 inches) at the commencement of the month, and fell on the 4th and 7th, after which it rose quickly till the 12th, when it fell, and again rose to the 18th. A rapid fall succeeded, and a partial recovery was followed by unimportant fluctuations. The mean of barometric pressure was rather higher than the means for the month of September in previous years. The mean temperature was about 2½ degrees above the average, the highest maxima recorded being 84·1° at Loughborough, 82·0° at Henley-in-Arden, 78·2° at Hodsock, 77·2° at Strelley, and 76·5° at Coston Rectory—all occurring on the 17th. In the rays of the sun, 130·8° was registered at Loughborough on the 13th, 126·0° at Hodsock on the 17th, and 123·2° at Strelley on the 9th. The night temperatures were comparatively high; minimum readings of 30·0° at Coston Rectory, 32·0° at Henley-in-Arden, and 32·3° at Hodsock, were registered on the 30th. At Loughborough, at 8 a.m. on the 10th, the minimum for the previous twenty-four hours was as high as 60·0°, and on fifteen nights the minimum was above 50·0°. Rain-fall was much below the average, and forms a strong contrast to that of September, 1883. The total values during the past month were:—Henley-in-Arden, 1·35 inches; Loughborough, 1·19 inches; Strelley, 1·13 inches; Coston Rectory, 0·98 inches; Hodsock, 0·83 inches. At none of these stations did the fall in twenty-four hours reach 0·40 of an inch. Dews were abundant, so that the root crops did not suffer through lack of moisture. Thunderstorms were "conspicuous for their absence," considering the high temperature and the (apparently) favourable conditions. Sunshine was above the average. The wind direction was variable, its force generally moderate, with, occasionally, fresh breezes.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

Notes from Woking.—Perhaps the following *facts* in connection with the economy of an insect which (from its resemblance to an Ichneumon Fly) is often overlooked, may be of interest to the readers of the "Midland Naturalist," and induce them to watch more closely the habits of these wonderful creatures, whose life histories are but little known. On June 27th I started out for a ramble across one of the commons here. The brilliancy and heat of the sun was something to be felt and remembered. Very few insects were about, but at 12.30, on arriving at one of the numerous bare patches on the common, I observed a Sand Wasp (*Miscus campestris*) dart across my path and "pitch" on to the sand in front of me. It immediately commenced to walk rapidly about, keeping its antennæ in constant motion, tapping the ground as if in search of something. I concluded that in crossing and recrossing the spot I had inadvertently covered up the entrance to its burrow. So I quietly sat down and watched its movements. After scratching away the sand it came upon its burrow, down which it went, but not quite out of sight; it backed out almost immediately, bringing in its jaws a small pebble which just about fitted the burrow. The wasp then flew a distance of four inches and dropped the pebble, flew back to the burrow, entered, and went out of sight, but only for less than thirty seconds, when it backed out again, and I expected to see it fly away, instead of which it flew to the pebble, took it up in its jaws, flew back to its burrow, *dropped the pebble in, and then flew away*. It returned in some thirty-five seconds, entered its burrow for a few seconds, backing out again, bringing in its jaws the pebble which it had but a minute before dropped down the hole; flying away a distance of nine inches it dropped its load, immediately returned to its burrow, around which it strutted and turned about exactly like a cock pigeon. It then entered, and stayed in the burrow about half a minute, and on backing out flew to and picked up the same pebble, with which it flew back to its burrow and *once more* dropped it in; then it commenced to collect smaller pebbles, each one being placed most carefully down the hole until it was almost filled up level with the surface. The wasp then collected smaller grains of sand, and after placing these in she took several jawfuls of the finest sand close to the hole, making the ground quite level, over which she strutted a number of times, then flew on to the heather, pinching off a dead capsule, which was placed in a careless manner just on one side of where the burrow had been; a small twig of heather, half an inch long, was next laid near the capsule, then a dead leaf and another capsule, until it was impossible to detect the exact place of the burrow. The wasp had now made twenty-seven gatherings of pebbles, sand, capsules, &c., and was apparently satisfied, for after a final strut round it flew away, and though I waited some ten minutes it did not return. It occupied just 7½ minutes in completing its work. Was it instinct or reason which enabled this wasp to protect its eggs during its absence by placing the pebble down its burrow?—Fred. Enock.

Alternaria Brassicæ (Berk.), Sacc.—A question is asked (p. 269 ante) by Mr. W. B. Grove as to Saccardo's figure of this species representing the spores attached by the *wrong* end. Saccardo figures two forms. Mr. Grove does not say to which of them he alludes. Figure 736 (Fung. Ital.) represents a plant on *Brassica oleracea* referred by the author to Berkeley's *Macrosporium Brassicæ*, but differing in size from that; he calls it "forma *minor*." The spores are represented as detached from the sporophores with the small end downwards, which is doubtless the ordinary position, and to me this is nothing more nor less than *M. Brassicæ*, Berk., as Saccardo himself thinks—to me not even a form. In figure 1206 of the same work he represents another form on *Citrus aurantium*, which he calls "forma *citri*," in which the spores are represented in various positions, one with the small end downwards and three with the small end upwards. It is this figure to which I suppose Mr. Grove refers, but knowing how variable the outline assumed by some of the congeners of this plant is, I would not venture to say that Saccardo has misrepresented it; nor yet because some of them are borne on the sporophores the small end upwards that it is not a form of Berkeley's species. Some experience in examining these lower fungi inclines me to allow rather wide limits for variation of contour of spores. I have this moment under the microscope a spore of *Macrosporium Brassicæ*, Berk., with a stem-like prolongation of the two ends, fusiform in fact. Corda represents *Alternaria tenuis*, Nees., with narrow ends upwards and downwards; Saccardo as having them upwards.—William Phillips, Shrewsbury.

SAXIFRAGA CERNUA.—It will be interesting to some botanists to learn, on the authority of Dr. F. Buchanan White (see "Scottish Naturalist," October, 1884), that this plant, which has been supposed to maintain itself on Ben Lawers indefinitely without producing seeds, has of late years at least been annually found in flower on that mountain, and is even extending its ground. It does not follow, of course, that it has produced perfect seed (of this nothing is said); but its flowering *prima facie* withdraws one argument from those who put it forward as contradicting the Spencerian doctrine of the *necessity* of fertilisation for the continued permanence of a species.—W.B.G.

THE BRITISH MOSS FLORA.—Part VIII. of this superb publication of Dr. Braithwaite's has just been issued. It is devoted entirely to the Tortulaceæ, and contains six exquisitely engraved plates. We shall review this in our next number.

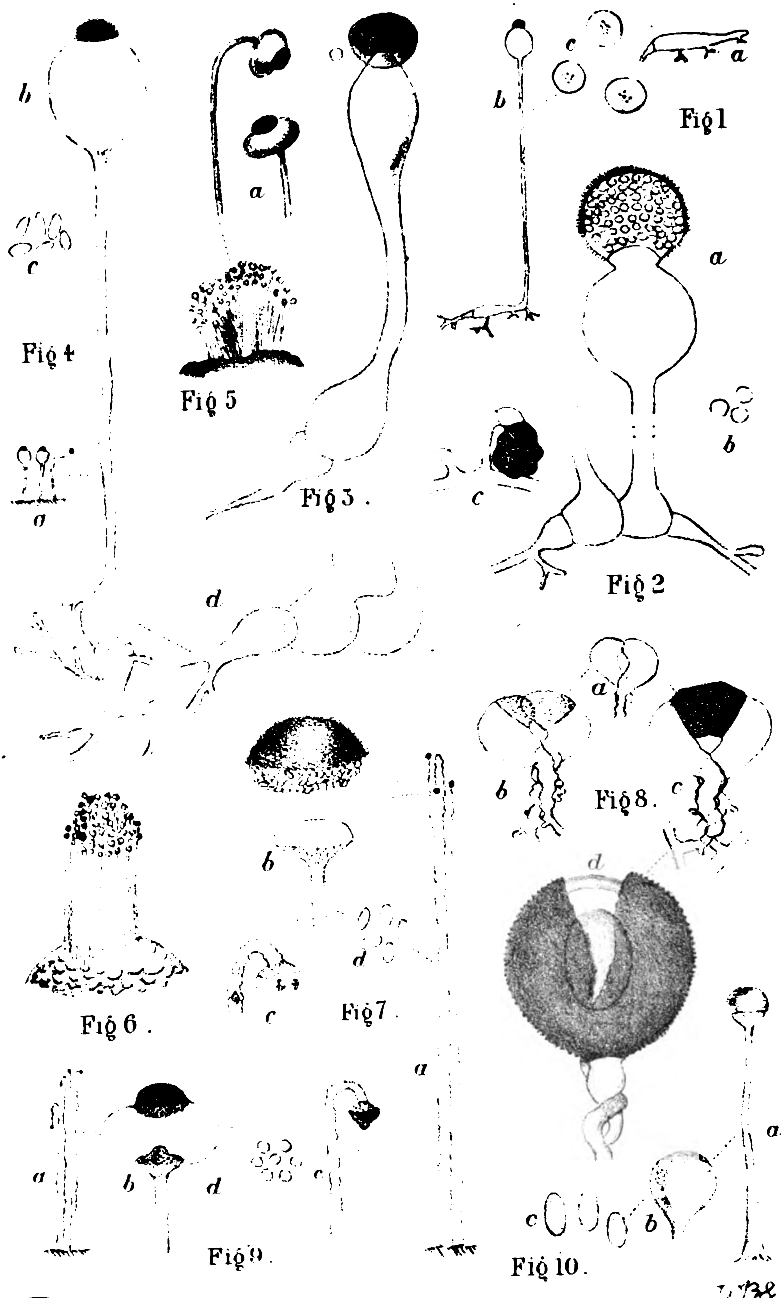
GEORGE BENTHAM.—We omitted to mention in the last number the death of this veteran botanist, which took place on September 10th. It will not be necessary to enter upon the details of his work here, as that has been fully done in an article in "Nature" of October 2nd; but it may be permissible to draw attention to the coincidence, by which his death followed at no long interval after the completion of the great work in which he was associated with Dr. Hooker—the "Genera Plantarum"—at which he laboured for twenty-one years. His health had previously shown signs of weakness, but as soon as his long-continued labours were at an end it rapidly gave way, and he died within a few days of his eighty-fifth year.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, held September 30th.—Mr. Bolton exhibited *Asplanchna priodonta* and two new rotifers recently found near Birmingham and named by Dr. Hudson *Conochilus dossuarius* and *Pompholix sulcata*. Mr. Udall exhibited the head of the stag beetle, *Lucanus cervus;* Mr. Marshall, plants, &c., from the United States and Canada. GENERAL MEEEING, held October 7th.—Mr. J. T. Blakemore exhibited *Spongilla lacustris* from Edgbaston Reservoir, and Saprolegnia on a dead entomostracan. Mr. W. B. Grove, B.A., exhibited the following fungi:—*Cortinarius hinnuleus*, *Agaricus testaceus*, and *Arcyria nutans*, from Bradnock's Marsh; *Arcyria punicea*, *Trichia chrysosperma*, *Dictydium cernuum*, from Sutton; and the fruit of the Spindle tree, showing the beautiful scarlet aril; he also exhibited quaternate spores of an agaric *in situ*. Mr. W. R. Hughes exhibited *Crenilabrus Melops*, the corkwing wrasse, and *Gasterosteus spinachia*, the fifteen-spined stickleback, from the Menai Straits; he also exhibited the head of *Vanessa urticæ* (smaller tortoiseshell butterfly), and a very young specimen of *Hippocampus brevirostris* (the sea horse), showing the gill tufts; both the latter specimens were mounted by Mr. F. W. Sharpus, London. Mr. T. H. Waller exhibited felspar crystals, showing zones of the glassy ground-mass of the lava shut in during the stages of growth, and basalt lava from Montserrat, West Indies; also minute intergrowth of felspar and quartz felsite from St. Davids, South Wales. Mr. J. F. Goode exhibited *Spirogyra quinina* in conjugation, and a section of chalk, showing organisms. Mr. R. W. Chase exhibited the following birds, nests, and eggs:—Birds: *Tringa subarquata*, in summer plumage, Breydon Broad; *Xema Sabinii*, near Coleshill; *Calcarius lapponicus*, male and female, in summer plumage, Norway; *Fratercula arctica*, immature, caught in Broad Street, Birmingham; *Uria grylle*, male, immature in winter plumage, Farne Islands; *Uria grylle*, male, in nearly full summer plumage, which is very remarkable, as this specimen was shot February 1st, 1884, Farne Islands. Nest and eggs of *Anthus pratensis*, *Acrocephalus streperus*, *Acrocephalus phragmitis*, *Emberiza schœniclus*, *Fringilla cœlebs*, and *Accentor modularis*, each of the above containing egg of *Cuculus canorus*, the common cuckoo. Nest and eggs of *Panurus biarmicus*, *Emberiza miliaria*, and *Cinclus aquaticus*. Mr. France exhibited a fasciated stem of the garden nasturtium. Mr. Lowe exhibited foraminifera from chalk. Mr. T. Bolton exhibited a fungus or alga growing inside the body cavity of the bag-rotifer, *Asplanchna*. Mrs. Browett exhibited some nuts from which oil is extracted in the South Sea Islands; also pods of a cotton plant (*? Gossypium*). Mr. J. Morley exhibited the head of a parasitic bee mounted without pressure. Biological Section and Sociological Section (combined meeting), held October 14th.—W. R. Hughes, F.L.S., in the chair. Professor Hillhouse, B.A., gave a most interesting and instructive exposition of chapter xi. of Herbert Spencer's Principles of Biology, "Classification." This was followed by a discussion, in which Messrs. W. R. Hughes, W. B. Grove, B.A., J. T. Collins, and F. J. Cullis took part. Mr. Bolton exhibited *Paludicella Ehrenbergi*, *Fredericella Sultana*, *Plumatella repens*, &c., Miss Jermyn, *Glaucium luteum*, the horned poppy, from Eastbourne; Miss Taunton, lichens, *Cladonia cornucopioides*, *C. pyxidata*, *C. rangiferina*, from New Forest; Mr. J. E. Bagnall, fungi, *Agaricus mappa*, *Ag. muscarius*, *Ag. clavipes*, *Ag. maculatus*, *Ag. spectabilis*, *Cantharellus cibarius*, *Lactarius turpis*, *L. deliciosus*, *Boletus luridus*, &c., from near Shustoke; and for Mr. G. S. Tye, fungi, *Agaricus rachodes* and *Ag. alcalinus*, from his garden at Handsworth. Microscopical General Meeting, held October 21st.—Mr. J. E. Bagnall exhibited, on behalf of the Rev. D. C. O. Adams, *Agaricus Bloxami* from near Tetsworth, and on behalf of Dr. Cooke *Agaricus pyriodorus*, *Ag. atratus*, *Ag. rusticus*, *Cortinarius triumphans*, and *Geaster fimbriatus* from near Hereford, and *Paxillus atro-tomentosus* from Surrey. Mr. Bagnall also exhibited *Agaricus saponaceus*, *Ag. tuba*, *Ag. galericulatus*, var. *calopus*, *Ag. cervinus*, *Ag. furfuraceus*, *Ag. ericæus*, *Ag. retirugis*, *Cortinarius hinnuleus*, *C. caninus*, *Lactarius controversus*, *L. pyrogalus*, *Russula consobrina*, var. *sororia*, *R. fellea*, *R. depallens*, *Lentinus cochleatus*, *Boletus parasiticus*, *B. pachypus*, *Peziza badia*, *Cordyceps militaris*, and many others. Some of these species are new to the district. Miss Taunton exhibited *Coprinus comatus* from St. Thomas's Churchyard. Mr. Bolton exhibited *Merismopædia glauca*. Mr. W. B. Grove exhibited a fine specimen of *Merulius lachrymans*, the "Dry-Rot," from a manufactory at Smethwick; also *Agaricus flavo-brunneus*, *Cortinarius gentilis*, and *Dædalea confragosa*, from Windley Pool, Sutton. Dr. M. C. Cooke read a paper on "The Life History of an Alga," which will appear in a future number of the "Midland Naturalist." Geological Section, October 28th.—Mr. T. H. Waller, B.Sc., read a paper on "The Igneous Rock of Penmaenmawr." This is a mass of enstatite diabase, becoming fine-grained and slightly porphyritic at the edge; it also contains many light-grey veins, which prove to be considerably more acid than the general mass of the rock, and to show a beautiful micropegmatite structure. The paper was illustrated by photographs of views and sections shown by the lime-light. Mr. W. B. Grove exhibited *Ag. heteroclitus* (rare, not found here since 1881), *Ag. mappa*, *Boletus badius*, *Ag. acutesquamosus* (rare, new to the district), *Ag. squamosus*, *Russula drimeia*, *R. depallens*, *R. integra*, *R. fragilis*, *R. ochroleuca*, *R. nigricans*, *R. cyanoxantha*, *Fistulina hepatica*, and *Sporodinia grandis*, all from Sutton and Sutton Park. Mr. J. E. Bagnall exhibited *Ag. (Tricholoma) imbricatus*, new to Warwickshire; *Boletus chrysenteron*, and other fungi; for Mrs. E. Hopkins, *Sphagnum rigidum* var. *compactum*, *S. cuspidatum* var. *falcatum*, *S. tenellum*, *S. acutifolium* var. *purpureum*, *Polytrichum commune* var. *minus*, and other mosses from Hampshire.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 22nd. Mr. Dunn exhibited, on behalf of Mr. Baxter, specimens of larvæ of Pale Tussock Moth, *Orgyia pudibunda*, popularly known as the "Hop Dog;" Mr. Hawkes, *Centaurea nigra*, with fungus, *Puccinia compositarum*; Mr. Insley, a collection of fossils from the Red Crag of Essex, also a number of sharks' teeth from Eocene formation. Under the microscope, Mr. Tylar showed poison bag, gland, and fang of spider, *Epeira diadema*; Mr. Foster, young spiders, just hatched, and zoëa of shore crab; Mr. J. W. Neville, palate of *Doris flammea*; Mr. Hawkes, seeds of *Parnassia palustris*; Mr. Bradbury, section of young vegetable marrow.—September 29th. Mr. Delicate, a specimen of long-eared bat, *Plecotus auritus*; Mr. Hawkes, a Lichen, *Cenomyces deformis*, in fruit; Mr. Deakin, *Puccinia Menthæ*, on garden mint; Mr. Moore, *Bulimus obscurus*, *Pupa secale*, and other shells, from Swanage. Under the microscopes, Mr. Foster showed tongue of honey bee; Mr. J. W. Neville, a section of Yoredale Limestone, with goniatites *in situ*. Mr. Betteridge then read a paper (the first of a series) on the "Birds of the District."—October 6th. Mr. Moore exhibited a collection of Caddis cases, showing various materials and modes of structure; Mr. Darley, ichneumon flies from cocoon of *Vanessa atalanta*; Mr. Hawkes, the resting stage of a fungus, *Claviceps purpurea*, on Lolium. Under the microscopes, Mr. Grew showed peculiar fibre in Japanese paper by polarised light; Mr. Hawkes, eggs of house fly; Mr. Foster, water spider, *Argyroneta aquatica*; Mr. J. W. Neville, comb-footed ichneumon fly, *Ophion luteum*. A paper was then read by Mr. Hawkes on the "Rise and Progress of Systematic Botany," which described the early knowledge of plants as pursued by herbalists on account of their curative properties. The work achieved by Gerard Tradescant and Nehemiah Grew was enlarged upon. The systems of Tournefort, Ray, Linnæus, and Jussien were then reviewed, the basis of each being pointed out, with the additions made by later botanists. The paper concluded by describing some of the natural divisions of the vegetable world, and was rendered simpler by a number of diagrams.—October 13th. Mr. Bradbury exhibited a specimen of Sweet Scabious, showing an abnormal growth consisting of a tuft of leaves springing from the centre of the receptacle; Mr. Insley, bony plates of Ichthyosaurus, from the Blue Lias clay; Mr. J. Betteridge, the following birds: Dunlin, *Tringa alpina*; Ringed Plover, *Ægialites hiaticula*; Curlew Sandpiper, *Tringa subarquata*; Common Sandpiper, *Tringoides hypoleucos*; and Sanderling, *Calidris arenaria*, all from Rhyl; Mr. J. A. Grew, a book, "The Anatomy of Plants, with an Idea of a Philosophical History of Plants," by Nehemiah Grew, dated 1682, which was much admired for the beauty of the plates. Under the microscopes Mr. Tylar showed silk glands of spider and sting of wasp, with poison gland, duct, &c.

Plate VI



THE PILOBOLIDÆ.

ON THE PILOBOLIDÆ,

WITH A SYNOPSIS OF THE EUROPEAN SPECIES, AND A DESCRIPTION OF A NEW ONE.

BY W. B. GROVE, B.A.,

HON. LIBRARIAN OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 309.)

3.—PILOBOLUS CRYSTALLINUS, Tode.

Kristall-Schwämmchen, O. F. Müller (174), "Kleine Schriften," p. 122, pl. 7 (1782).

Mucor obliquus, Scopoli, "Flor. Carn.," ii., 494 (1772).

Hydrogera crystallina, Weber, "Prim. Flor. Hols.," p. 110 (1780)—Ehrh., "Beytr.," iii., 122—Vahl, "Flora Dan.," vi., 1080—Roth, "Fl. Germ.," i., 557.

Pilobolus crystallinus, Tode, "Schrift. Nat. Berl. Gesell.," v., 46, pl. 1 (1784); "Fung. Meck. Sel.," i., 41 (1790)—Persoon, "Obs. Myc.," i., 76, pl. 4, f. 9-11 (1796); "Syn. Meth.," p. 117 (1801)—Schum., "Saell.," ii., 188 (1803)—Alb. et Schw. "Consp.," p. 72 (1805). Link, "Diss.," i., 32, f. 50 (1809); "Spec. Pl.," vi., 95; Handbk., iii., 480 (1833)—Nees, sen., "Syst.," p. 85, f. 81 (1816)——Fries, "Syst. Myc.," ii.,

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PLATE VI.

DESCRIPTION OF THE FIGURES.

Fig. 1. *Pilobolus longipes:* (*a*), basal reservoir; (*b*), full-grown specimen; (*c*), spores (after Van Tieghem).

Fig. 2. *P. nanus:* (*a*), sporange, swelling, and intercalary mycelian apophyses; (*b*), spores; (*c*), stylospore (after Van Tieghem).

Fig. 3. *P. exiguus* and spore (after Bainier).

Fig. 4. *P. roridus:* (*a*), three specimens, nat. size; (*b*), another × 25; (*c*), spores × 380; (*d*), two mycelian apophyses × 50 (after Van Tieghem).

Fig. 5. *Mucor roridus:* at *a*, two separate sporangia (after Bolton).

Fig. 6. *Fungus Virginianus* (after Plukenet).

Fig. 7. *Pilaira Cesatii:* (*a*), three specimens, nat. size; (*b*), a sporange after dehiscence × 90; (*c*), summit of stem after fall of sporange, enclosing crystalloids of mucorine of two forms—one a hexagonal plate: the others, octahedra × 90; (*d*), spores × 380 (after Van Tieghem).

Fig. 8. *P. Cesatii:* formation of zygospore × 200; in *d*, which is ripe, the warted exospore, the smooth thick endospore, and the large central oil-drop are shown; (*a*, *b*, *c* after Van Tieghem, *d* after Brefeld).

Fig. 9. *P. nigrescens:* (*a*), four specimens, nat. size; (*b*), a sporange after dehiscence × 90; (*c*), summit of stem after fall of sporange × 90; (*d*), spores × 380 (after Van Tieghem).

Fig. 10. *P. dimidiata:* (*a*), plant with young sporange × 80; (*b*), columella × 120; (*c*), spores × 500 (from nature).

308 (1822); iii., 312 (1832); "Sum. Veg. Sc.," ii, 487 (1849)—Wahl., "Flor. Suec.," ii., 999—Decand., "Fl. Fr.," ii., 271; "Mém. du Mus.," pl. 14, f. 4, *a* and *b* (1815)—Grev. "Fl. Edin.," p. 448 (1824)—Maisonneuve, "An. Sc. Nat., Ser. 1, ix., 221 (1826)—Léveillé, "Mém. Soc. Linn. Par.," iv., 622, pl. 20, and do. figs 1-6 (sub *P. rorido*)—Desmaz. "An. Sc. Nat.," ser. 1, x., 145 (1827)—Montagne, "Mém. sur gen. Pil.," p. 5 (1827)—Linn., "Syst. Veget.," iv., pt. 1, p. 519 (1827)—Gachet, "Mém. Soc. Linn. Bordeaux," ii., 159 (1828)—Bischoff, "Hand. Bot. Term.," ii., p. 1012, f. 3724, and f. 3725 (sub *P. rorido*)—Mérat, "Flor. Par.," i., 40—Chevallier, "Flor. Par.," ed. 2, i., 73, pl. 4, f. 27—Wallr. "Fl. Germ.," ii., 318 (1831)—Berkeley, "Eng. Fl.," p. 231 (1836); "Grevillea," iii., 149, *ex Carolina, U.S.A.* (1875); *non* "Intell. Obs.," vi., 252—Nees, jun. "Syst." i., 32, pl. 5 (1837)—Raben., "Kr. Fl.," i., 135 (1844); "Herb. Myc.," ed. nov., No. 78; "Fung. Eur.," No. 270—Loudon, "Encyl. Pl.," p. 1024, f. 16349 (1829)—(?) Guigneau, "Mém. Soc. Linn. Bordeaux," xviii (1852-3)—Bail, "Bot. Zeit. Mohl," p. 629 (1855)—Fuckel, "Symb. Myc.," p. 73 (1869); exs. 49—Cooke, "Handb. Br. Fung.," p. 633 (1871)—Luerssen, "Hand. Syst. Bot.," i., 62 (1879)—Bucknall, "Proc. Bristol Nat. Soc.," ii., 348 (1879)—Vize, "Cat. Pl. Forden" in Coll. Powys-land Club, xv., 1, part 30—Stevenson, "Myc. Scot.," p. 291 (1879)—Saccardo, "Myc. Ven.," 495; "Fung. Ven.," v., 172 (1876).*

Mucor urceolatus, Dickson, "Fasc. Pl. Crypt.," i., 25, pl. 3, f. 6 (1785)—Bolton, "Hist. Fung.," iii., No. 169, pl. 133, f. 1 (1789)—Bulliard, "Champ.," i., 111., pl. 480, f. 1 (1790)—Sowerby, "Eng. Fungi," pl. 300 (1796)—Withering, "Brit. Pl.," ed. 4, iv., 394 (1801)—Purton, "Midl. Fl.," ii., No. 1123 (1817).

Pilobolus urceolatus, Purt., *l. c.*, iii., 325, pl. 31 (1821).

Non *P. crystallinus*, Cohn.

Sub-species *a.*—**P. EU-CRYSTALLINUS.**

P. crystallinus, Corda, "Icon.," vi., 12, pl. 2, f. 32 (1854)—Coemans, "Bull. Acad. Roy. Belg.," viii., 770, f. 1-16 (1859); "Monogr.," p. 57, pl. 2, f. 1-20 (1861)—Van Tieghem, "Nouv. Rech. Muc.," *ex* An. Sc. Nat., p. 43 (1875); "Trois. Mém.," *ibid.*, p. 24, pl. 10, f. 4, 5 (1878)—Bainier, "Etude," p. 41 (1882).

P. microsporus, Brefeld, "Bot. Unters.," iv., 70, pl. 4., f. 16, 19-22 (1881).

Stem slender, elongated; swelling ovoid; basal reservoir roundish, generally concealed; spores pale yellow or nearly colourless, equal, elliptic, 8-10$\mu \times$ 5-6μ. (Pl. iv., fig. 16.)

Stem 5-7 mm, high. Basal reservoir sometimes intercalary. Sporange black above, sometimes marked with hexagonal reticulations in white, one hexagon at the top, surrounded by a circle of others. Columella conical, dingy. Spores with no distinct epispore, not germinating in water, but only in a nutrient solution, somewhat flattened at the sides, having a greenish tinge in the mass. I have met with this species in company with *P. Kleinii*, each retaining its proper characters. Van Tieghem's contention, that the presence of the hexagonal reticulations is a specific character, is unfounded.

On all kinds of dung; common. Paler than *P. Kleinii*.

England, Scotland (?), France, Belgium, Germany, Austria, America (?).

*Many of the quotations under this head are perhaps referable to other species.

4. Sub-species *b*.—**P. KLEINII**, Van Tieghem.

Pilobolus roridus, Currey, "Linn. Journ.," i., 162, pl. 2 (1857).
Pilobolus crystallinus, Klein, "Zur Kennt. Pil.," p. 360, pl. 23-7, f. 1-52 (1870)—Brefeld, "Bot. Unters.," iv., 70, pl. 4, f. 15 (1881).
Pilobolus Kleinii, Van Tieghem, "Trois. Mém.," p. 26, pl. 10, f. 6-10 (1878)—Saccardo, "Myc. Ven.," No. 454—Bainier, "Etude," p. 43, pl. 2, f. 14-5 (1882)—Grove, "Journ. Bot.," p. 131, pl. 245, f. 4 (1884).

Stem rather slender; swelling ovoid; basal reservoir roundish, generally concealed; spores orange, oval, unequal, averaging $15\mu \times 8\mu$. (Pl. iv., figs. 1-8, 10-13.)

Stem not as high as in *crystallinus*; basal reservoir never intercalary; sporange never reticulated. Columella sometimes colourless; spores bright orange, not granular, germinating only in decoction of dung or other nutrient solution. There is usually a band of orange granular matter at the base of the swelling, which is wanting in *P. eu-crystallinus*.

On all kinds of dung; probably common, but for a long time confounded with *P. eu-crystallinus*.

England, France, Germany, Italy.

P. KLEINII, forma **SPHÆROSPORA**, mihi.

Pilobolus lentigerus, Corda, "Icon.," i., 22, pl. vi.. f. 286 (1837)—Raben., "Krypt. Fl.," p. 136 (1844)—Bonorden, "Handbk.," p. 128 (1851)—Coemans, "Monogr.," p. 62 (1861).
Pycnopodium lentigerum, Corda, "Icon.," v. 18 (1842); "Anleit.," p. 71, pl. C, f. 25 (1842).
Pilobolus crystallinus, Bonorden, "Handbk.," p. 128, pl. 10, f. 203 (1851), "*die sporen sind rund und gelb.*"
Pilobolus œdipus, Brefeld, "Bot. Unters.," iv., 69, pl. 3, f. 1-10; pl. 4, f. 11-14 (1881)—vars. *b* et *c*, Klein, *l.c.*, p. 360, pl. 27, f. 50; pl. 26, f. 40 *b* (1870).
Pilobolus Kleinii, forma *sphærospora*, Grove, "Journ. Bot.," p. 132, pl. 245, f. 5 (1884).
Sub *P. Kleinii*, Van Tieghem, "Trois. Mém.," p. 26 (1878).

Stem shorter than in the normal form; spores round, sometimes irregular, orange, 16-21μ, often granular. (Pl. iv., fig. 9.)

With *P. Kleinii*, at the beginning of growth, passing gradually into the normal form. The spores vary considerably in size. The figures and descriptions of the authors quoted show that they had this form before them, and not, as has been surmised, *P. œdipus*. Corda's *P. lentigerus* is only a badly nourished form, such as is often met with. Coemans' *intermedia* is the transition form from this to *P. Kleinii*.

England, France, Germany, Austria.

5.—**PILOBOLUS LONGIPES**, Van Tieghem.

Pilobolus longipes, Van Tieghem, "Trois. Mém.," p. 27, pl. 10, f. 11-15 (1878)—Bainier, "Etude.," p. 46, pl. 2, f. 11-13 (1882).
Pilobolus roridus, Brefeld, "Bot. Unters.," iv., 70, pl. 4, f. 17 (1881).

Stem tall, slender; swelling ovoid; basal reservoir long, cylindrical, creeping, external; spores orange, equal, oval or almost globular, $13\mu \times 11\mu$, with a thickened sometimes bluish-black membrane. (Pl. vi., fig. 1.)

Stem much taller than in any other species, 2-3 or even 5 cm. high. Sporange ½ mm. in diameter. Columella conico-cylindric, bluish-black. Spores dark green in the mass. Basal reservoir 1½-2 mm. long, rooting. Swelling 1 mm. or more broad.

On horse and dog dung.

France, Germany.

6.—P. RORIDUS, Persoon.

Fungus (a stercore equino), Ray, "Hist. Plant.," ii., 1928 (1688); iii., 24 (1704); "Syn. Meth.," ed. ii., p. 322 (1699); ed. iii., p. 13 (1724) —Petiver, "Gazophyl.," pl. 105, fig. 14 (1711).

Fungus virginianus, Pluk, "Phyt.," pl. 116, f. 7.

Mucor roridulus, Withering, "Bot. Arr.," ed. 1, ii., 784 (1776).

Mucor roridus, Bolton, "Hist. Fung.," iii., No. 168, pl. 132, f. 4 (1789)—Withering, "Brit. Pl.," ed. 4, iv., 394 (1801)—Relhan, "Flor. Cantab.," p. 579 (1820).

Pilobolus roridus, Persoon, "Syn. Meth.," p. 118 (1801)—Schumacher, "Saell.," ii., 188 (1803)—Alb. et Schwein., "Consp. Fung.," p. 72 (1805)—Link, "Spec. Pl.," i., 96; "Handb.," iii., 480 (1833)—Fries, "Syst. Myc.," ii., 309 (1822); iii., 312 (1832); "Summ. Veg. Sc.," p. 487—Linnæus, "Syst. Veget.," iv., pt. 1, p. 519 (1827)—Loudon, "Encycl. Pl.," p. 1024, f. 16349 (1829)—Berkeley, "Eng. Fl.," v., 231 (1836)—Raben., "Krypt. Fl.," i., 135 (1844)—Bonorden, "Handbk.," p. 128 (1851)—Bail, "Bot. Zeit. Mohl," pp. 629-35 (1855) —Coemans, "Monogr.," p. 61, pl. 2, f. B (1861)—Cooke, "Handbk. Br. Fung.," p. 633 *pro parte* (1871)—Van Tieghem, "Nouv. Rech. Muc.," p. 46, pl. 1, f. 7-13 (1875)—Stevenson, "Myc. Scot.," p. 291 (1879)—Vize, "Cat. Pl. Forden"—Bainier, "Etude," p. 44, pl. 2, f. 16 (1882).

Pilobolus microsporus, Klein, "Zur Kennt. Pil.," p. 360, pl. 27-8, f. 53-67 (1870).

Non *P. roridus*, Léveillé, *nec* Bischoff, *nec* Currey, *nec* Cooke, fig. 301, *nec* Brefeld. Probably also some of those quoted above belong to *P. crystallinus*, when no figure is given.

Stem long, slender, cylindrical, colourless; swelling globular; sporange hemispherical, depressed, black, much smaller in diameter than the swelling; basal reservoir usually intercalary, concealed; spores elliptic, faintly yellowish in the mass, 6-8$\mu \times$ 3-4μ. (Pl. vi., figs. 4-6).

Stem 1-2 cm. high, with less colour than in any other species. Swelling abrupt. Dew-drops very abundant. Columella flatly convex, dingy.

On the dung of horse, hare, etc. Sometimes occurring with *P. crystallinus* (?)

England, France, Germany. Not common.

7.—PILOBOLUS NANUS, Van Tieghem.

Pilobolus nanus, Van Tieghem, "Trois. Mém.," p. 29, pl. 10, f. 16-22 (1878).

Stem short, slender; swelling globular; sporange globular, yellow, of the same diameter as the swelling, with a small apophysis; basal reservoirs globular, intercalary, two, three or even five together; spores colourless, homogeneous, spherical, 3·5-4μ. (Pl. vi., fig. 2.)

The whole plant is colourless except the sporangial membrane. Stem hardly 1 mm. high. Columella flatly convex, inserted above the base of the terminal sphere, so as to leave a small apophysis. This species produces, on the same mycelium, on short lateral recurved branches, stellate stylospores, which are colourless or faintly yellow, 15—20μ in diameter.

On excrement of rats.

France; rare. July.

II. PILAIRA, Van Tieghem.

Stem erect, continuous, with no septum at the base, no swelling above. Sporange not projected, otherwise as in Pilobolus. A thick gelatinous layer between the spores and the columella. Spores as in Pilobolus.

1.—PILAIRA CESATII, Van Tieghem.

Pilobolus anomalus, Cesati in Klotzsch, "Herb. Myc.," No. 1542, *cum descript.* (1851)—Hoffmann, "Index Myc.," p. 64 (1860)—Coemans, "Monogr.," p. 63 (1861)—Fuckel, "Symb. Myc.," p. 73 (1869); exs. 2203—Brefeld, "Bot. Unters.," iv., 60-5, pl. 4, f. 18, 23-8 (1881), *pro parte*.

Ascophora Cesatii, Coemans, *l.c.*, p. 65, pl. ii., f. E (1861).

Pilobolus Mucedo, Brefeld, *l.c.*, i., 27, pl. 1, f. 25, 6 (1872).

Pilaira Cesatii, Van Tieghem, "Nouv. Rech. Muc.," p. 52, pl. 1, f. 14-24 (1875)—Bainier, "Etude," p. 29, pl. 1, f. 16-8 (1882)—Grove, "Journ. Bot.," p. 132, pl. 245, f. 6 (1884).

Stem tall, slender, cylindrical, colourless, becoming flexuose, sporange at first spherical, then hemispherical, black, with a small granular apophysis; columella hemispherical, colourless; spores oval, equal, yellowish in the mass, 8-10$\mu \times 6\mu$.* (Pl. vi., figs. 7, 8.)

Stem 1-2 cm. high, when the sporange is first formed, afterwards increasing to 10-12 cm. When the sporange dries somewhat, the apophysis disappears within as in Ascophora. This species produces zygotes which are black, oval, 100$\mu \times 120\mu$, adorned with numerous minute warts, formed by two unequal conjugating cells.

On the dung of horse, ass, pig, rabbit, goose.

England, France, Germany. Probably common.

2.—PILAIRA NIGRESCENS, Van Tieghem.

Pilaira nigrescens, Van Tieghem, "Nouv. Rech. Muc.," p. 60, pl. 1, f. 25-8 (1875)—Bainier, "Etude," p. 32 (1882).

Stem shorter, more slender; apophysis small; columella blackish; spores spherial, unequal, 5-6μ, faintly yellowish in the mass. (Pl. vi., fig. 9).

Distinguished by its spores, and its conical, bluish or violet-black columella.

On excrement of rabbit.

France; rare.

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* Coemans gives the size of the spores 13-16$\mu \times 10\mu$, Brefeld 7·5$\mu \times 4\mu$ (according to the figure, but the text says: "·006 mm. broad"); I found them 11-12$\mu \times 7\mu$.

3.—PILAIRA DIMIDIATA, mihi.

Pilobolus anomalus, Brefeld, *l.c.* pro parte (1881).
Pilaira inosculans, mihi, *olim*, " Mid. Nat.," vi., 119 (1883).
Pilaira dimidiata, Grove, " Journ. Bot.," p. 132, pl. 245, f. 7 (1884).

P. stipite curto, gracili, æquali, apice denique nutante; sporangio primo flavido, demum nigro; columellâ leviter coloratâ, convexâ, prope æquatorem vesiculæ apicalis insertâ, itaque apophysin magnam hyalinam præbente, ubi adest in fungo vegeto constrictio profundula; sporis hyalinis, dilutissime flavidis, elliptico-oblongis, 12-14$\mu \times$ 5-6μ. (Pl. vi., fig. 10.)

Stem ½-1 mm. high, when the sporange becomes black; afterwards increasing to 3-4 mm. Sporange ·10-·12 mm. in diameter. Distinguished from *P. Cesatii*, not only by its much smaller size, but also by its peculiar apophysis, which is almost as large as the sporange, but slightly less in diameter and not granular. It can scarcely be a badly nourished form of *P. Cesatii*, as it grew luxuriantly on a rich substr tum.

On dog's dung. March, April.

England; rare. Met with in one locality only, Worcestershire.

This concludes the known species of Pilobolidæ. It will be seen that they form a close series, which, taken in conjunction with the Mucoridæ, clusters around two points, *Pilobolus Kleinii*, and *Pilaira Cesatii*. The affinities of the species, considered in the light of evolution, are very curious. We must suppose that a Mucor possessed, as many Mucors are, e. g. *Mucor plasmaticus*, of an abundance of the interstitial gelatinous substance in its sporangium, became provided with an upper indurated cap, and a lower diffluent zone. Many species of Mucoridæ do show a decided difference in the persistence of different parts of their sporangial membrane, e.g. Circinella. The sporange would thereby be enabled to drop off its stem, with the spores included. This would probably be an advantage in one respect, as preserving the spores from adverse influences, till sufficient moisture was obtained to enable them to germinate.

But it would be accompanied by a drawback, in that the diffusion of the spores would be less complete; thus we should not expect the species of Pilaira to be widely spread. But now the faculty of intercalary growth, possessed by that portion of the stem of Pilaira and Mucor situated immediately beneath the sporangium, would vary slightly, allowing of a growth in breadth instead of length. If then a septum arose at the base, so as to permit of the attainment of sufficient tension in the swelling, we should inevitably arrive at the projection of the sporange, in the way in which we know it to take place. Thus the spores would be widely dispersed. At the same time, the thick layer of gelatinous substance, which was almost a necessity in Pilaira, since by its swelling the sporange was removed from the stem, would tend to diminish in quantity as it has done in Pilobolus; but as it would still have a use in binding the spore-mass together, it would not entirely disappear.

Having then arrived at *P. crystallinus*, and *P. Kleinii*, we must regard *œdipus* as a degraded form, connected with the latter by the *forma sphærospora*, and *exiguus* as a still lower stage. On the other hand *longipes*, the most splendid species of the group, is an advancement on *Kleinii*, and must be considered as the highest type to which the evolution of the Mucorini, in this direction, has yet advanced.

Since it would appear, then, that the species of Pilaira show us a distinct stage in the evolution of Pilobolus, at which they themselves have remained, while the true Piloboli have undergone a considerably greater development, the intermediate connecting forms having disappeared, we have a sufficient justification for the view (propounded by Van Tieghem and adopted here) which places these two sets of species in two distinct genera. It is on such a basis, in fact, mainly, that genera can be satisfactorily established.

A FUNGUS FORAY IN THE MIDDLETON DISTRICT.

During a recent visit of the eminent Fungologist, Dr. Cooke, to Birmingham, I availed myself of this advantage to make an excursion in his company to a district in which I have long felt an interest, and from which I have recorded from time to time many good and rare fungi. The district lies between Sutton and Middleton, and includes Middleton Heath and the two prolific woods, Trickley Coppice and New Park. Trickley Coppice appears to be comparatively recent as a woodland, and doubtless in the days of Ray was a part of Middleton Heath; New Park, however, is historic, and claims a special interest from its being more than once mentioned by Ray, in his *Synopsis Methodica* and *Catalogus Plantarum*, for rare and interesting botanical treasures, notable among which is *Osmunda regalis*, the Royal Fern. The district still retains many of its old features; everywhere you see evidences of its former heathlike characters. The waysides abounding in bramble, furze, heath, ling; here and there, though now at rare intervals, the sheep's scabious; and in former times, as we may see by a letter from Ray to Mr. Lister, dated Middleton, 1669, the beautiful trailing stems of the cranberry, the heathlike bushes of the black crowberry, and, I have no doubt, the still more rare whortleberry were to be found; but these are now merely records of the past. *Scirpus cæspitosus* was also to be found in this district in Ray's time, but so far as I have yet seen, this is also eradicated. Many of the fungi recorded by Ray were from this district, and it was from an interest in this great man's work, and from a desire to see how many of the plants recorded by him were still to be found, that I began some ten years since to visit this district. My experience had taught me that the district was a rich one, and as it was also a most accessible one, I chose it for our excursion. As on this occasion Dr. Cooke and myself made notes of every Fungus that came within our ken, it may interest others to know what was noted. I may state that every fungus was carefully examined in the field, the more critical ones brought home for more thorough examination, and many of them afterwards exhibited at the Natural History Society's meeting on the following Tuesday. The list of Fungi found I give below. Several of the species therein recorded are new to the district, and these I have put in italics. Many of them are rare and all were interesting, and gave a charm to a long but beautiful walk.

Agaricus vaginatus
,, phalloides
,, mappa
,, rubescens
,, granulosus
,, melleus
,, *imbricatus*
,, saponaceus
,, phyllophilus
,, infundibuliformis
,, *tuba*
,, brumalis
,, *ditopus*
,, metachrous
,, laccatus
,, platyphyllus
,, butyraceus
,, maculatus
,, dryophilus
,, *rancidus*
,, galericulatus
,, var. *calopus*
,, filopes
,, galopus
,, epipterygius
,, cervinus
,, nidorosus
,, pascuus
,, squarrosus

Agaricus rimosus
,, geophyllus
,, tener
,, hypnorum
,, *furfuraceus*
,, æruginosus
,, sublateritius
,, fascicularis
,, *ericæus*
,, semilanceatus
,, udus
,, spadiceus
,, corrugis
,, semiglobatus
,, separatus
,, *retirugis*

Coprinus atramentarius
,, niveus
,, plicatilis

Cortinarius *caninus*
,, hinnuleus
,, *decipiens*

Paxillus involutus

Hygrophorus pratensis
,, virgineus

Hygrophorus ceraceus
,, psittacinus

Lactarius turpis
,, *controversus*
,, pyrogalus
,, pallidus
,, quietus
,, glyciosmus
,, mitissimus
,, subdulcis
,, camphoratus

Russula nigricans
,, depallens
,, cyanoxantha
,, consobrina
,, var. *sororia*
,, fœtens
,, fellea
,, ochroleuca
,, fragilis
,, integra

Russula alutacea

Marasmius peronatus
,, rotula

Lentinus cochleatus

Boletus luteus
,, flavus
,, *parasiticus*
,, chrysenteron
,, pachypus
,, edulis
,, luridus
,, scaber

Polyporus versicolor

Sterium hirsutum

Peziza *badia*

Coniceps militaris

JAMES E. BAGNALL.

THE LATE DR. T. WRIGHT, M.D., F.R.S., F.G.S.

Dr. T. Wright, M.D., F.R.S., F.G.S., Medical Officer of Health for the town of Cheltenham, and president of the Cheltenham Natural Science Society, after a long and painful illness, died at his residence, in St. Margaret's Terrace, on the night of November 17th, in the seventy-sixth year of his age.

He was born at Paisley, Renfrewshire, N.B., on November 9th, 1809, and educated at the Grammar School of that town, being subsequently articled to his brother-in-law, a surgeon and general practitioner. After the completion of his articles he proceeded to Ireland, and entered as an anatomical and surgical student in the Royal College of Surgeons, Dublin, where he became the pupil of Professors Jacob and Harrison and Drs. Benson and Houston in anatomy, and Professors Colles and Willmot in surgery. He subsequently entered the Peter Street Anatomical School, under Messrs. Kirby and Ellis, where he was selected as assistant demonstrator; all the preparations and dissections for Professor Ellis's lectures being made by him.

He became a member of the Royal College of Surgeons, London, in 1832, and graduated at the University of St. Andrews in 1834: shortly after which he settled in Cheltenham, where his life was subsequently passed in the active practice of his profession. He was elected surgeon to the Cheltenham Dispensary, continuing so for fifteen years, and for twenty years was surgeon to the General Hospital. When the

Literary and Philosophic Association was founded he became one of its most active members, and was for some time its President. During different sessions he delivered several courses of lectures on comparative physiology, natural history, and palæontology.

During the earlier period of his professional life he devoted much time to microscopic anatomy, but owing to the effect it had on his eyesight he turned his attention more particularly to Palæontology, selecting the oolitic rocks of the Cotteswold Hills as his especial field for study. Indefatigable as a worker he first made a large collection of the echinoderms, not only from localities in the vicinity but likewise from other oolitic formations, respecting the minute anatomy of which he read to the Cotteswold Field Club a series of memoirs, which were published in the "Annals and Magazine of Natural History." These attracted the attention of Professor Edward Forbes, F.R.S., who proposed to Dr. Wright that they should conjointly write a monograph on the British Fossil Echinodermata for the Palæontographical Society, those of the cretaceous and tertiary epochs being described and figured by the former and the oolitic ones by the latter. Professor Forbes, however, died prior to the completion of his portion of the work, consequently when Dr. Wright had finished the oolitic Echinidæ he was requested by the council of the society to undertake his late colleague's allotted task; this he acceded to, and in 1860 commenced the description, with figures, of all the cretaceous species, which occupied him more than twenty years, and forms a large quarto volume of 370 pages with 80 magnificent plates.

In 1875, at the solicitation of the council of the same society, Dr. Wright commenced an extensive work upon the "Lias Ammonites of the British Isles," materials for which he had been collecting for upwards of forty years, and which was completed in 1883 in a volume consisting of 500 pages of text, with nearly ninety plates. The whole of these works constitute four large quarto volumes, with 234 plates and 1,553 pages of descriptive letterpress. During this time he examined many public and private collections both in British and Foreign museums in order to compare all indigenous forms with such as are found on the continent. The accomplishment of this self-imposed task was the pleasure and delight of his life, and the Council of the Geological Society awarded him the Wollaston gold medal. He was elected a Fellow of the Royal Society of Edinburgh in 1855, of the Geological Society in 1859, and of the Royal Society of London in 1879.

He took a deep interest in all subjects which tended to raise the moral or intellectual character of his fellow-men, and when asked was always ready and willing to lecture upon useful subjects. A fluent and impressive speaker, he appeared to throw some new light upon every question which he touched, while no one was ever more ready to afford information to or assist a worker upon any subject he was engaged upon.

Having been elected one of the Improvement Commissioners in 1853 he applied himself to solve many sanitary problems, while his advice was invaluable respecting the best method of obtaining water for the requirements of the town from the pure sources in the Cotteswold Hills instead of from the more polluted Severn. In 1873 he was offered and accepted the post of Medical Officer of Health for Cheltenham, Charlton Kings, and Leckhampton, on terms which rendered it necessary for him to retire from private practice.

In 1877, when the Cheltenham Natural Science Society was instituted, he was unanimously elected as its first President, and at each annual meeting this selection has been re-endorsed. Under his auspices this Society has flourished and now numbers nearly 100 members, by one and all of whom he will be greatly missed. Not only will it be difficult to supply his place in an adequate manner, but also as an authority on the geological formations of Gloucester he had no equal, while his works on Echinoderms and Ammonites are universally admitted to be the best monographs which have appeared on these subjects.

On the occasion of the visit of the Midland Union of Natural History Societies to Cheltenham, in 1881, he was elected President, and delivered an able and important address on "The Physiography and Geology of the Country round Cheltenham."

It is to be hoped that the splendid collections of fossils which he has left behind him will find their way into some public museum.

His funeral was attended, as a mark of respect and esteem, by the Mayor and Town Council of Cheltenham, the members of the medical profession of the town, and also of Gloucester, the members of the Natural Science Society, the President and Secretary of the Cotteswold Field Club, and many of the local residents of Cheltenham and its vicinity.

Dr. Wright leaves behind him one son and two daughters, the elder of whom is married to E. Wethered, Esq., F.G.S., F.C.S., and the younger to the Rev. C. Wilcox, Vicar of Exton-Normanby.

The following are some of the more important works and papers on Natural Science which were published by Dr. Wright. At first he confined himself to his favourite study of Comparative Anatomy, and wrote a memoir on a rare British Dolphin, *Delphinus tursio;* next a paper on Dr. Buckland's theory of the action of the siphuncle in the pearly nautilus, *Nautilus pompilius;* "On the Comparative Structure of the Skeletons of Zoophytes"; "An Outline of the Comparative Structure of the Organs of Locomotion in Radiated Animals"; "On the Comparative Anatomy of the Organs of Vision in the Animal Kingdom"; "On the Maxillary Poison Glands of *Grophilus longicornis*; and in 1855 a translation, greatly enlarged, of Agassiz and Gould's "Outlines of Comparative Physiology."

In 1850, "A Stratigraphical Account of the Section of the North-West Coast of the Isle of Wight." In 1851, "A Stratigraphical Account of the Section of Hordwell, on the Hampshire Coast"; "On the Cidaridæ of the Oolites, with a Description of some New Species of that Family." In 1852, "Contributions to the Palæontology of the Isle of Wight." 1856, "Monographs on British Fossil Echinodermata"; "Palæontographical and Stratigraphical Relations of the Sands of the Inferior Oolite." 1857, "On the Fossil Echinoderms from the Island of Malta." 1858-9, "Monographs on the British Fossil Echinidia." 1860, "The Subdivisions of the Inferior Oolite in the South of England." 1861, "Fossil Oolitic Asteroidea." 1863, "Fossil Echinidæ of Malta;" "Ammonites of the Lias Formation." "On the Fossils from the Middle Lias of Dumbleton." 1864—67, "British Fossil Echinodermata from the Cretaceous Formations." 1866, "On Coral Reefs, Present and Past." 1867, "Monograph on the Oolitic Ophiuroidea." 1869, "On the Correlation of the Triassic Rocks of the Côte d'Or and the Cotteswold Hills." 1875, "On the Geological and Palæontological Characters of the Country around Bristol," being his Presidential Address to the Geological Section of the British Association at the Bristol Meeting. 1878, "The Lias Ammonites of the British Islands," Part I.—IV. 1882, "The Cretaceous Echinodermata," completed. 1883, "The Lias Ammonites," completed.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

ANNUAL CONVERSAZIONE.

The Annual Conversazione of this Society was given in the Town Hall, Birmingham, on November 4th. There was the usual large display of microscopes on the floor of the Hall; beneath these, in number over sixty, there were exhibited a series of objects illustrating the "Short Synopsis of Natural History" which has recently been published by the Society. Among these objects were the following:—Mr. E. H. Wagstaff exhibited *Amœba proteus* and various infusoria, including *Spirostomum ambiguum* and *Bursaria truncatella;* Messrs. J. Udall and A. J. Webb, Polycistina; Mr. A. C. Goode, Sea Soundings of "Challenger" Expedition; Mr. J. T. Blakemore, *Spongilla fluviatilis* and *Cristatella mucedo;* Mr. W. R. Hughes, Sponges, Hydroids, Echinoderms, and Polyzoa; Messrs. E. de Hamel and W. G. Davy (of Tamworth), *Hydræ;* Mr. Rabone, *Hydra fusca*, *Stephanoceros*, and *Lophopus crystallinus;* Mr. J. Levick, *Carchesium polypinum* and *Notommata aurita;* Mr. H. Hassall, *Sida crystallina;* Mr. J. F. Goode, *Daphnia pulex;* Mr. W. Graham, Larva of Crab, and a Hydroid, *Campanularia*, with expanded polyps; Mr. H. J. Sayer, Head of Wasp; Mr. H Miller, English Diamond Beetle and section of Echinus Spine;

Mr. C. T. Parsons, Tongue of Cat; Mr. C. H. Saunders, Feet of Spider; Mr. J. Edmonds, Ova of Liparis; Mr. W. B. Grove, a Bacterium in the rod and coccus stage; Mr. J. Morley, *Arachnoidiscus;* Mr. W. P. Marshall, Fruit of Golden Fern and Anthers of Lily; Mr. J. E. Bagnall, Capsule of Scale-Moss and Peristomes of Mosses; Mrs. Rabone, *Volvox globator;* Mr. F. Derry, Spores of Osmunda; Professor W. Hillhouse, fifteen slides illustrating the Continuity of Protoplasm; Mr. S. Walliker, section of Couch Grass stem by polarised light; Dr. H. W. Crosskey, *Eozoon Canadense;* Mr. T. H. Waller, section of Obsidian from Mexico, showing polarisation by strain round a crystal; Mr. S. Allport, Spherulitic Rhyolite; Mr. J. Potts, Silex Avanturine, and Ancient Lava from Naples.

Mr. T. Bolton exhibited a number of slides showing insect scales arranged like flowers; mounted groups of Diatoms, one of which, of extraordinary beauty, was exhibited by Mr. J. F. Greenway; Marine Diatoms; Fresh-water Sponge; Skeleton of Frog (arranged by E. Wade Wilton); and a most beautiful and instructive series of Marine Animals, in tubes, from Naples, including Medusæ, Screw Coralline, Salpæ, and Tubularia. Mr. F. J. Cullis showed a number of living Lampreys from the Severn, also a preserved Sea Lamprey, and a series of Amphioxus. Mr. F. Enock exhibited a large number of slides mounted by himself, special attention being directed to a series of the Mymaridæ (the most minute winged insects in Great Britain), including *M. cosmocoma* and many as yet undescribed species. Mr. J. H. Shoebotham exhibited a large number of Photographs of Wood Sections, and took one (in thirty seconds) during the evening, showing and explaining the whole process.

In the galleries, Professor Hillhouse exhibited Models and Raw Materials illustrating the Chemistry of Beer, and a series of large diagrams illustrating the Vegetable Kingdom; Mr. W. Southall, thirty varieties of the Common Gourd (*Cucurbita Pepo*) grown in the open air; Mr. W. R. Hughes, *Euplectella aspergillum*, (Venus's Flower-basket Sponge), from the Phillipine Islands, and *Spongia oculifera*, from the chalk; and, on behalf of Mr. H. J. Carter. F.R.S., a beautiful Purple Sponge, *Suberites Wilsoni*, from Australia; Rev. W. Robinson, Ammonites from South Somerset; Mr. W. J. Harrison, a collection of Rocks, Fossils, and Meteorites, with models employed in teaching Physiology, etc.; Mr. S. Walliker, a number of interesting relics from Cyprus, including Vases, Effigies, and Lamps, a Moorish matchlock, Japanese Sword, Maté Teapot, etc.; Mr. J. E. Bagnall, a collection of Mosses from Bolton Woods, Yorkshire; Rev. H. Boyden, British Sea-Weeds; Mr. W. B. Grove, a large collection of Fungi, from Sutton Park, including *Cortinarius collinitus*, *Ptychogaster albus*, the rare *Russula drimeia*, and the edible species, *Agaricus rubescens*, *A. nebularis*, *A. ostreatus*, *Coprinus atramentarius*, and *C. comatus;* Mr. R. W. Chase, a much-admired collection of British Birds' Nests and Eggs; Mr. J. Gibbins, British Birds' Eggs. Collections of Birds and other Animals were also exhibited by Messrs. Franklin, Coburn Bros., and Spicer.

Mr. S. Henson exhibited a fine collection of Minerals, including some magnificent crystals of Stibnite, lately found in Japan. Crystals of this mineral are usually about one inch long; they have been found in this mine twenty-four inches long, and showing a number of faces previously unknown; he also showed models of Historical Diamonds, "Sherry-coloured" Topaz, from Siberia, and other minerals. Mr. C. J. Woodward exhibited Barytes Crystals, from Salop, and Minerals and Models used in teaching the Institute Mineralogy Class. Mr. G. W. Tait exhibited fragments from the vitrefied fort in Sutherlandshire.

In the department of Art and Archæology, Mr. W. R. Hughes exhibited a series of forty Portraits of Charles Dickens, from 1837 to 1870, and a number of large and striking illustrations to his works; Mr. W. B. Grove, a series of Drawings of Fungi by Rev. H. W. Lett, Lurgan, Ireland; Mr. Alderman White, Photographs of Tyrol and Alpine Scenery; Messrs. Watson and Robinson, Photographic Prints, taken by themselves; and Mr. J. Rabone, a Wax Medallion of Matthew Boulton from life; Napier's Rods (called, when made of ivory, Napier's Bones); Circles of Proportion; the Shakespeare Brooch, found at Stratford in 1828; Hooke's "Micrographia" (1667), the first book written on the microscope; and "Investigatio Arcana Rerum" (1696), by Leeuwenhoek, the first discoverer of the Infusoria.

Messrs. E. J. Love and W. J. Harrison exhibited a few physical experiments, and Messrs. C. J. Watson and C. R. Robinson demonstrated the production of lantern Photographs, in a dark room; some of these and other photographs taken by the members were exhibited during the evening in the lantern by Mr. C. Pumphrey. In regard to the number and interest of the objects brought together the Conversazione was inferior to none which have been given previously by the Society, but the attendance was unfortunately not equal to the expectations which had been formed.

METEOROLOGICAL NOTES.—October, 1884.

The barometer was rising at the commencement of the month; it experienced a slight check on the 2nd, and then rose rapidly to the 5th, when the amount of pressure exceeded 30·7 inches. A decided fall succeeded, and on the 10th the reading was below 29·5 inches. Another, more gradual, rise followed, and from the 21st pressure was unsteady, but increasing at the close of the month. Temperature was about two degrees below the average. In the earlier part of the month the range was rather wide, but towards the middle of the month the variations were but slight. No great extremes were registered; the highest were 63·7° at Hodsock, on the 18th; 63·6° at Loughborough;

62·0° at Coston Rectory; and 61·9° at Strelley; on the 16th upwards of 109° was recorded in the rays of the sun at Loughborough and Hodsock. The lowest minimum temperatures were 30·4° at Strelley on the 11th; 29·8° at Loughborough, and 29·5° at Coston Rectory on the 5th; and 29·6° at Hodsock on the 9th. On the grass 24·2° was recorded at Strelley on the 13th, and 25·6° at Hodsock on the 9th. Rainfall was decidedly below the average, and less than the amounts registered in October since 1879. At Strelley the total fall was only 0·88 of an inch; at Hodsock, 1·00 inch; at Loughborough, 1·11 inches; and at Coston Rectory, 1·21 inches. These amounts were distributed over from sixteen to eleven days. Some snow (with rain) fell at Loughborough on the 10th. Westerly gales were experienced towards the end of the month. Sunshine was below the average. A lunar halo was seen at Loughborough on the evening of the 29th.

WM. BERRIDGE, F.R. Met. Soc.

12, Victoria Street, Loughborough.

THE BRITISH ASSOCIATION.

A meeting of the General Committee of the British Association, adjourned from Montreal, was held in the Lecture Theatre of the Royal Institution, Albemarle Street, on Tuesday, 11th November last, at three o'clock in the afternoon, Lord Rayleigh, the President, in the chair, to determine (*inter alia*) upon the place of meeting for 1886. There was a large attendance. Invitations were submitted from Birmingham, Manchester, Bournemouth, and Melbourne. The deputation from Birmingham consisted of the Mayor and Town Clerk (representing the Town Council), Professor Haycraft, Professor Lapworth, and Professor Tilden (the Mason College), Mr. Councillor R. F. Martineau, and Mr. C. J. Woodward (the Midland Institute), the Rev. Dr. Crosskey, Mr. William Mathews, and Mr. Councillor Lawson Tait (the Philosophical Society), Mr. W. R. Hughes, Mr. George Maw, Dr. Norris, and Mr. Charles Pumphrey (the Natural History and Microscopical Society). The proposition that the Meeting of 1886 should be held at Birmingham was moved by Sir Frederick Bramwell, seconded by Mr. William Pengelly, and supported by Colonel Ratcliff. The Mayor, Professor Tilden, and Mr. Councillor R. F. Martineau having previously spoken in its favour (Manchester, which was represented by Sir Henry Roscoe and Professor Boyd Dawkins having gracefully withdrawn its claim and the other towns not having been proposed), the proposition was carried unanimously. Among the members of the Midland Union of Natural History Societies who attended to give support to Birmingham were Mr. E. de Hamel, of Tamworth, and Mr. F. T. Mott, of Leicester. As the last meeting of the British Association in Birmingham was held in 1865, an interval of twenty-one years will have elapsed by the time the next visit takes place. In a future number we shall call attention to the general and scientific progress of the town since the last visit of the Association. The annual meeting of the Midland Union taking place in Birmingham in 1885, there is a double honour in prospect for that town.

Natural History Notes.

JERUSALEM ARTICHOKE (*Helianthus tuberosus*).—This plant has bloomed in many parts of this country this summer; the flowers showing why the Italians gave it the name of *girasole* (sunflower), of which "Jerusalem" in our common name is merely a corruption. It is called an artichoke in allusion to the artichoke-like flavour of its roots. De Candolle shows that the old notion that it originated in Peru or Brazil is erroneous, and that it is a native of the north-east of America.

QUERY.—Can any reader of the "Midland Naturalist" tell me who is the author of the following lines:—

"To me the wilderness of thorns and brambles,
Beneath whose weeds the muddy runnel scrambles,
The bald-burnt moor, the marshy sedgy shallows,
Where docks, bull rushes, water flags and mallows,
Choke the rank waste, alike can yield delight;
A blade of silver hair-grass, nodding slowly
In the soft wind; the thistle's purple crown,
The ferns, the rushes tall, and mosses lowly,
A thorn, a weed, an insect or a stone,
Can thrill me with sensations exquisite;
For all are exquisite, and every part
Points to the Mighty Hand that fashioned it."

R. Rogers, Hampton-in-Arden.

HARICOT BEANS (*Phaseolus vulgaris*).—The origin of the word Haricot as applied to this plant has been a source of much controversy. De Candolle, in his "Origin of Cultivated Plants," says that chance has led him to find it. An Italian name, *araco*, found in Durante and Matthiolo, was given to a leguminous plant which modern botanists attribute to *Lathyrus ochrus*. Durante quotes the Greek ἄραχος as the synonym of his *araco*, which gives the clue to the etymology. Père Feuillée wrote in French *aricot*; before him Tournefort, who was the first to use the name, spelt it *haricot*, in the belief probably that the Greek word was written with an aspirate, which is not the case, at least in the best authors. Littré, in his dictionary, inclines to the theory that *haricot*, the plant, comes from the ragout called haricot or laricot* of mutton, given in some French dictionaries as the equivalent of "Irish stew," seeing that the latter is older in the language, and that a certain resemblance may be traced between the haricot bean and the morsels of meat in the ragout, or else that this bean was suitable to the making of the dish. As haricot beans are not used in making the ragout, as we find on reference to Soyer and other authorities on cooking, Littré's suggestion is evidently a misleading one; while De Candolle's seems perfectly satisfactory. Wedgwood in his "Dictionary of English Etymology" says, "*Haricot* is described as small pieces of mutton partly boiled and then fried with vegetables, but without any reference to *haricot* beans."

New British Puccinia.—A few weeks ago Mr. H. Hawkes, of Birmingham (*not* the Borough Coroner), sent me a few fresh leaves of Sonchus infested with a uredinous fungus, having a decidedly puccinioid aspect, which he was unable to make out. A microscopic examination under a low power at once revealed the presence of a remarkable palisade-like ring of long dark-brown clavate paraphyses surrounding the sorus of spores just within the ruptured encircling epidermis, which are characteristic of *Puccinia Sonchi* (Rob.), Desmazières. The quantity of material was but small, and continued examination failed to show that there were any teleuto-spores present, but the uredo-spores themselves show a marked character in the very thick warted exospore, so as to leave little doubt on my mind that I had before me this Puccinia, which has not hitherto been recorded for Great Britain. I have visited the place at Hamstead where the specimens were found, but was unable to see any more of the fungus; in fact, Mr. Hawkes said that he could find only two plants infected, all the leaves of which he gathered. For full description, with figures, see "Science Gossip" next month.—W. B. Grove, B.A.

Alternaria Brassicæ, Sacc.—While thanking Mr. Phillips for his reply, I beg leave to call his attention to the fact that he has mis-read my question. All the figures which he quotes were known to me. I suggested, not that Saccardo but that Berkeley might be wrong, and asked for information about Berkeley's original *Macrosporium Brassicæ*. Is it really an Alternaria? W. B. Grove, B.A.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY. — Biological Section, November 11th. — Mr. W. P. Marshall in the chair (in the absence of Mr. W. R. Hughes). The Chairman read the "Report on Marine Sponges obtained in the neighbourhood of Oban and the Island of Kerrera during the excursions of the Birmingham Natural History and Microscopical Society in the months of July of 1881 and 1883 respectively;" this was illustrated by a fine display of the objects described and commented upon. The report is drawn up by the eminent zoologist, Mr. H. J. Carter, F.G.S. Mr. T. Bolton exhibited preserved specimens from the zoological stations at Naples, and mounted specimens from Messrs. W. Watson, E. Ward, C. Vance Smith, W. Joshua, and the Rev. J. E.

* *Laricot* is a word of M. de Candolle's own coinage, we fancy.

Vize. Mr. J. H. Shoebotham, micro-photographs of transverse wood section of a runner from the Isle of Negro, and of the insects *Mymar pulchellus* and *Mymar cosmocoma*, both taken during the late conversazione from slides mounted by Mr. F. Enock. Mr. T. Clarke, mounted specimens of *Zoea* of *Porcellana* and the common shore crab from Jersey. Mr. J. E. Bagnall, *Agaricus tenuis*, *Ag. mammosus*, *Hygrophorus hypothejus*, *Boletus elegans*, *Gomphidius glutinosus*, and other fungi from near Great Packington; also microscopical preparations of mosses and hepatics. For Rev. D. C. O. Adams, *Pleurotus ulmarius* and other fungi from Hobsford. During the meeting the Chairman read a telegram from Mr. W. R. Hughes, Dr. Norris, and Mr. C. Pumphrey, announcing that the British Association had unanimously resolved to visit Birmingham in 1886. MICROSCOPICAL GENERAL MEETING, November 18th.—Mr. R. W. Chase in the chair. Mr. W. R. Hughes presented to the Society a copy of two Lectures by Dr. T. Spencer Cobbold, M.D., F.R.S., on "The Parasites of Meat, &c." Mr. Walter Graham exhibited a branch from a tree of *Eucalyptus Globulus*, grown from seed sown in 1882, and planted in the open ground at Acock's Green. Prof. Hillhouse, in his valuable remarks upon the tree, doubted its continuance in the open ground here, as he thought ten degrees of frost would kill the tree. Mr. H. Spencer Hughes exhibited a female specimen of the *Falco Tinnunculus*, the Kestrel Hawk, from Hamstead. Mr. Thos. Bolton exhibited *Ctenodrilus pardalis* (Claparède, 1863), or possibly another species, a marine worm of a rare genus. Professor Hillhouse then gave Part 5 of his researches in "The Continuity of Protoplasm, &c.," which he illustrated by sketches on the blackboard. His experiments proved that delicate threads of protoplasm penetrated not only the lamella between the pits in the cell wall, but also the cell wall itself. Mr. W. R. Hughes and others expressed their appreciation of the value of the paper, and the erudite and clear manner in which the Professor had treated the subject. A copy of the paper will appear in a future number of the "Midland Naturalist." SOCIOLOGICAL SECTION, November 20th.—The President, Mr. W. R. Hughes, F.L.S., in the chair. The evening was devoted to the study of Chapter XII. of Part II. of Mr. Herbert Spencer's Principles of Biology, on "Distribution." Mr. William Mathews, M.A., F.G.S., favoured the Section with a very able discourse on the subject, treating mainly of the distribution of plants, and giving the Section the benefit of his observations of the Floras of Europe and Algeria. Mr. Mathews's address was followed by a discussion opened by Professor Hillhouse, continued by Mr. C. H. Allison, Mr. J. B. Stone, J.P., Mr. J. E. Bagnall, Mr. F. H. Collins, and others, and closed with a general summary and reply by Mr. Mathews. November 22nd.—Excursion to "Dr. Johnson's Country," under the leadership of Mr. Sam: Timmins, J.P., F.R.S.L. On arriving at Lichfield the party, numbering fifty ladies and gentlemen, first visited the Museum, where many interesting relics of Dr. Johnson were seen; a visit was also paid to his monument and birthplace, and to the "Johnson's Head," at each of which places the visitors were allowed to inspect many valuable memorials. On arriving at the Cathedral the party was met by the Rev. Canon Lonsdale, who in a very happy and lucid manner pointed out the many beauties of the building, calling special attention to the restoration of the west front, now nearly completed. The party remained to service in the Cathedral, and had the pleasure of hearing Dr. Bridge's Anthem "It is a good thing to give thanks," perfectly rendered by the admirable choir. Dr. Erasmus Darwin's house was next visited; afterwards Mr. Bridgeman's studio, where busts of Dr. Johnson were inspected. Some very interesting relics were next shown by Mr. and Mrs. Lomax. After a substantial tea at the George Hotel, Mr. W. R. Hughes, the President of the Section, took the chair, and an eloquent and interesting address was delivered by Mr. Sam: Timmins on "Dr. Johnson and his connection with Lichfield." The address lucidly sketched the Doctor's career from his birth, through the years of school discipline, to the date of his last visit to Lichfield in 1784, shortly before his death. During the last visit he paid for a monument to be erected in St. Michael's Church, to the memory of his parents, but either it was never erected or the stone was lost. The address was enthusiastically applauded by a very appreciative audience. Votes of thanks to the Rev. Canon Lonsdale, Mr. Sam: Timmins, Mr. and Mrs. Lomax, Mr. Thomas Clarke, and Mr. Bridgeman, who had contributed to the pleasures of the day, brought the proceedings to a close. Geological Section, November 25th.—Mr. Waller, President, in the chair. *Exhibits*:—Mr. Bolton, (1) mounted specimens of *Acineta grandis*, with pseudopodia extended; (2), parasitic growth within a *Closterium*. Mr. W. P. Marshall, fossils found in Coprolite Pit, near Potton, Bedfordshire. Mr. W. B. Grove, the following fungi: *Didymium pertusum*, *Valsa ceratophora*, *Rhinotrichum Thwaitesii*, var. *cinnamomeum*, and *Cephalosporium Acremonium*, var. *major*, from Bradnock's Marsh; *Sphæria spermoides* and *Agaricus infundibuliformis*, from Sutton; *Erysiphe umbelliferarum*, *Fusidium album* and *Puccinia sonchi* (new to Britain), from Hamstead. Mr. Waller, specimen of Obsidian from the Yellowstone district, collected by Mr. C. Pumphrey. The section shows that, before the final consolidation of the rock, spherulites formed, occasionally isolated, but most frequently coalesced into bands. Later on these shared in the crumpling of the rock in its further flow, and after the consolidation of the glass, a coarser and more normal formation of spherulites has taken place, enveloping in most cases the bands of the first set of spherulites, which are very transparent, and only show their radial structure in polarised light. Mr. W. H. Wilkinson, the following plants from Scotland: *Geranium sylvaticum*, *Raphanus raphanistrum*, *Alchemilla alpina*, also a specimen of Phyllody of the bracts of *Plantago major (Plantago deformis)*, each bract developed into a long leaf-like expansion by which the inflorescence was nearly hidden. The President drew the attention of the Section to the loss which the Society had suffered in consequence of the death of Dr. Wright, of Cheltenham, corresponding member of the Society. He also informed the Section that the General Committee had passed a vote of condolence with Dr. Wright's son. Mr. Hughes also spoke in the warmest terms of the many and valuable services rendered to the Society by the late Dr. Wright. Mr. Cullis informed the Section that a felsitic boulder had been discovered in making an excavation in Cherry Street, near the Cobden Coffee House.

THE BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 20th.—Mr. J. W. Neville exhibited fossil ferns, from Albion; Mr. Dunn, a collection of plants, from Feckenham Bog; Mr. Sanderson, an artichoke gall on oak. Under the microscope, Mr. C. P. Neville showed a garden centipede, with its peculiarly arranged tracheal system. October 27th.--Mr. Moore showed a case of hoverer flies and drone flies. Mr. Tylar, under the microscope, a section of carboniferous limestone, from Froghall, with foraminifera *in situ*; Mr. Moore, stomach of drone fly, with pollen grains; Mr. Insley, antheridia and archegonia of moss. Mr. J. Betteridge then read his second paper on the "Birds of the District." November 3rd.—Mr. Madison exhibited several varieties of *Bulimus acutus*, from different localities. Under the microscope, Mr. Tylar showed a slide of Thymol in process of crystallisation, by polar light. Mr. J. W. Neville, Diatomaceæ, from deposit in Black Root pool, Sutton Park; Mr. Moore, tongue of stag beetle (*Lucanus cervus*). November 10th.—Annual Meeting for the election of officers for the ensuing year. Mr. C. E. Beale, C.E., was elected president, and Messrs. H. Hawkes and J. W. Neville, vice-presidents. The retiring president, Mr. J. W. Neville, then delivered an address on "The Offensive and Defensive Weapons of Insects," remarking that as the subject was a wide one, he should only take that part of it that referred directly to ourselves. It might appear necessary to some to apologise for introducing into respectable company some of the insects to which he should have occasion to refer. But these would not be naturalists, for naturalists studied living objects as they were, whether they pleased the sentiments or no. The offensive weapons of the following insects were then referred to: *Pediculus capitis*, *Nepa cinerea*, *Notonecta glauca*, *Cimex lectularius*, and *Pulex irritans*. The peculiarities of their mouth organs were described and compared with a typical insect's mouth, that of the ground beetle, Carabus, when the remarkable departure from a probable original type was made apparent. In the latter part of the subject the sting of the wasp was described with its complicated mechanism of poison bag, duct with chitinous rings, pistons for ejecting poison, lancets, etc. The address concluded by regretting that the labours of microscopists were often of a desultory character, and pointing out the advantages of more special pursuits. The use of the various forms and ornamentation of pollen grains was suggested as good ground to be worked by microscopic botanists. The Entomostraca, Diatomaceæ, and Desmidiaceæ of the district were mentioned as fields of labour where good and useful work was required, and local catalogues much needed. The address was illustrated by diagrams.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D. Zoology and Botany.—The monthly meeting of the Section was held on Wednesday evening, November 19th. Members present, twenty-one. Miss Shenton exhibited a number of beautiful coloured drawings of Leicestershire Fungi, her own work; Mr. W. A. Vice, very stunted specimens from the South Downs of *Campanula glomerata* and *Jasione montana*; Mr. F. Bates, a specimen of moss from Kew Gardens enveloped in a mass of parasitic alga (*Scytonema muscicola*); Mr. F. T. Mott, a sample of water from Cropstone Reservoir containing a quantity of a minute granular alga (*Cœlosphærium?*), which chokes the filter beds at this season; also magnified and coloured drawings of the same. Mr. F. Bates read a short paper on the "Measuring of Microscopic Objects," and explained the method which he recommended, viz., to keep an eyepiece micrometer permanently in each ocular, to determine the value of its divisions for each power by a stage micrometer, and to make a table of these values in decimals of an inch and of a millimetre for ready reference. The size of any object in the field could then be determined with the least possible trouble. A discussion ensued on the importance of acquiring by practice facility in the use of the metric scale. It was necessary to fix in the mind the image of some metric datum. All Englishmen had a mental image of the inch. It would be well to acquire in a similar way an image of the millimetre, as the twenty-fifth of an inch, about equal to the thickness of a thick card. A sub-committee was appointed to consider the question of better accommodation, as the Section was outgrowing the present room at the museum.

THE MIDLAND NATURALIST

THE JOURNAL OF THE
"MIDLAND UNION OF NATURAL HISTORY SOCIETIES,"
WITH WHICH IS INCORPORATED THE ENTIRE
TRANSACTIONS OF THE BIRMINGHAM NATURAL
HISTORY AND MICROSCOPICAL SOCIETY.

EDITED BY
E. W. BADGER & W. J. HARRISON, F.G.S.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

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PREFACE.

The Editors gladly avail themselves of the opportunity to publicly thank their many able contributors for the valuable papers sent in for publication during the present year. It has been a source of much pleasure to them to have had the privilege of publishing Mr. J. E. Bagnall's "Flora of Warwickshire," the last instalment of which appears in the December number. This important work will no doubt be issued in a complete form before very long, and when it is it will be found to be largely added to, Mr. Bagnall having devoted all his leisure, since the publication began in the Magazine, to the further study and investigation of the Flora of his native county.

The Editors would once more urge their readers to send for publication short notes on natural history topics embodying their personal observations. Communications of this kind would add materially to the value of the "Midland Naturalist."

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THE MIDLAND NATURALIST.

"Come forth into the light of things,
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PENMAENMAWR.*

BY T. H. WALLER, B.SC.

Between the villages of Penmaenmawr and Llanfairfechan, on the coast of North Wales, there lies a mass of igneous rock forming the mountain from which the former place takes its name. The seaward face falls so precipitously that to carry the road along the coast the solid rock has had to be cut away, and to allow the railroad to pass a tunnel has been made through the projecting spur. At the height of about 1,000ft. above the sea there is a considerable space of table-land, with a nearly level surface, from which a rough peak rises to about another 500ft. Several quarries have been opened in the mass, as the stone is in considerable demand both for squared setts and for macadamising roads. Of these the most westerly lies just above the village of Llanfairfechan, the floor of the uppermost working being about 900ft. above the sea. In this quarry the sharply jointed character of the rock at once strikes the eye, and it is specially well seen in a large mass which is just now left in the form of a great tooth, at the edge of the floor. It is this jointing which makes it so well adapted for paving setts, and the smooth, flat surfaces are conspicuous in many of the railway bridges of the neighbourhood, distinguishable from artificially worked surfaces only by their rusty-brown skin of weathered stone. The stone does not, so far as I saw it, exhibit any of the gently curved surfaces which are so common in the Rowley Rag; and I saw no instance of the spheroidal weathering which is so characteristic of our local stone, and no approach to columnar structure, unless a very marked and curious—almost stratified—appearance in the extreme edge of the mass towards the west can be considered such.

* Transactions of the Birmingham Natural History and Microscopical Society. Read October 28th, 1884.

So far as I know, the character of the rock has been mentioned only by Professor Rosenbusch, Mr. J. A. Phillips, and Mr. J. J. Harris Teall. By the former it is stated that "the traps of Penmaenmawr and Conway, in North Wales, belong to the Enstatite-bearing Diabases, of which they are indeed most typical examples." Mr. Phillips, in a paper in the "Quarterly Journal of the Geological Society," 1877, p. 423, gives a detailed account of the varieties to be observed in the mass, giving analyses showing the different stages of alteration, and a description of the mineralogical character as determined microscopically. He considers the mineral associated with the felspar to be hornblende, recognising its slight dichroism but overlooking its rhombic crystallisation. I shall have to refer to this paper again later on. Mr. Teall tells me that he has mentioned the Penmaenmawr stone in his paper on the Whin Sill of the North of England, which he read before the Geological Society in June, but the paper has not yet been published, so I cannot say to what extent he has investigated it. I believe, however, only so far as to confirm the description given by Rosenbusch. The specimens which I obtained while staying at Llanfairfechan this summer are all from the western end of the mass, which, however, Phillips states to be the least altered by weathering.

On making our way towards the quarry we find, as soon as we get clear of the village and come upon any rock, that it is slate, the planes of cleavage (or deposition) dipping towards the igneous mass, though probably the dip is not much affected by the latter. This continues until we arrive at the rough wooden ladders which the quarrymen have fixed in a cleft in the rock to facilitate their laborious journey to and from work. Here we find the igneous rock, and can trace it inwards, gradually changing in character for a few feet. The first we come to is split up into quite thin plates, and this structure, on a large scale, gives its peculiar appearance to the line of cliff which forms the boundary of the mass.

A little further in the rock is very compact, sometimes of a light grey colour, sometimes almost black, but usually containing a quantity of white patches which are either felspar crystals or minerals replacing them. On examining a specimen of this microscopically, we find it to be almost entirely made up of interlacing felspar crystals, with occasional porphyritic ones of larger size, and in the interstices I think we may detect a small amount of residual glassy matter. In one specimen, which, however, I got from a wall in the village, there are dark veins and patches which, on examination, proved to be the parts where the felspar is clearest of opaque granular enclosures, due probably to some amount of decomposition. I saw no similar specimen certainly *in situ*, but one or two in such situations that I have no doubt of their being derived from the mountain immediately above them; and one of them occurred in a part which was much more obviously and coarsely crystalline. This border portion has occasionally a well-marked conchoidal fracture; one specimen shows concentric rings, though unfortunately they are not perfect.

In one of my specimens from this fine-grained border of the mass, a very remarkable felspar crystal occurs. It is one of the larger ones—probably of an older generation—which imparts a slightly porphyritic character to this part of the rock; but only one end is visible, and that is of an irregularly oval shape. Over the greater part of the extent of the section there is fairly normal twinning, with angle of 48° between the extinctions of the two sets of lamellæ, which suggests labradorite; but all round the visible edge there is a narrow zone, which is apparently of such different composition that its optical position is quite different from that of the kernel so to speak, although it is obviously continuous with it as to its crystal shape. It extinguishes so very nearly at 45° from the direction of the trace of the twinning plane that it is difficult to say whether it is twinned or not, but I believe not. Strictly speaking, it appears to be made up of a considerable number of very narrow parallel zones, with very slightly different extinction angles.

The ladders already spoken of land us at the level of the quarry, or very nearly so; and from the pathway round the corner of rock which we have to pass, the views over the country westward and Anglesey are very fine. Possibly as we linger here out of sight of the working, we may be surprised to see what seems like a fog drift over us and pass away up the valley to the south. It is, however, dry, and smells dusty, and is the dust arising from the throwing down the seaward face of the mountain the waste stone of the quarry. The quantity so disposed of is enormous, amounting sometimes I was told to 1,800 truck loads per week, and has resulted in the disfiguring fans of bare stones which are so unfortunately conspicuous from Llanfairfechan.

In the quarry we find that we are on the highest of three floors, each of which is being extended further and further into the hill, while the edge of each of the two upper ones is being invaded by the one immediately below it. The stone is worked in the usual manner, the jointing of the rock being taken advantage of to reduce the labour of getting it down.

After a blast, the men loosen the shaken masses with crowbars, their safety being as far as possible secured by ropes fixed at the top of the face of the rock on which they are working.

An examination of the rock in this section shows that it is composed of felspar, and a rhombic pyroxene, with a very few crystals of augite. The felspar is in the usual elongated forms and is triclinic, but its exact species is not certain; although from the fact that six extinctions were measured betwen 54° and 56°, it is almost certain that labradorite is present. In specimens from this quarry it is pretty fresh and free from decomposition, but in other parts it is not in such good condition. The augite and the enstatite are very similar in appearance, and where the plane of the section has happened to cut across the prism I do not think they are distinguishable. They are both pale in colour—the augite is perhaps a little darker. When the section is more or less parallel to the prism, however, the difference of crystal system is at once shown. Speaking generally, the long narrow sections of enstatite "extinguish" when the length is parallel to the principal plane of one of the nicols prisms, whilst in the case of the monoclinic augite this only happens in the case of the section being in the zone of the orthopinacoid and base. In all other cases, and they are naturally likely to be much the most numerous, the length of the crystal when it "extinguishes" makes an angle with the planes of the nicols, which may vary from 40° downwards. The colours in polarised light which the enstatite shows are paler and more washed out than those of the augite, and the latter does not show the slight dichroism which characterises the former, giving a green or yellow tint according to the position of the crystal section with regard to the principal plane of the polarising prism. Some of the crystals are twinned. When some decomposition has taken place the pyroxenes are replaced by a fibrous green mineral.

Of this constituent of the rock Phillips says:—"The form of these crystals is seldom sufficiently perfect for complete identification, but some of them are strongly dichroic, and their structure is that of hornblende; others, which are very pale in colour, are not distinctly dichroic." The colour he describes as "light greenish brown."

A few flakes of light brown mica are met with here and there, characterised by their strong dichroism and pronounced cleavage.

Irregularly distributed through the stone are certain grey veins and patches of apparently coarser texture, called by the quarrymen "spar," and much disliked, as they refuse to "cut" cleanly as the normal stone. I think it likely that Phillips refers to these when he says, "In one of the sections examined a group of felspathic crystals, $\frac{1}{20}$ of an inch in length, which do not exhibit the structure of plagioclase, is enclosed in the finely crystalline base." Of these grey portions I procured a considerable quantity, as I thought the crystals would be sufficiently large to permit of the separation and identification of the felspar. This hope was disappointed, as on account of the minute intergrowth of quartz and felspar, the veins are capital examples of micropegmatite. The felspar also is filled with an opaque white dust, probably due to decomposition. The amount of quartz present seemed so great that an analysis promised to be of interest, and so it turned out, for in addition to showing 6·6 per cent. more silica than the general mass of the stone, as analysed by Mr. Phillips, the prevailing alkali is potash instead of soda. The analyses are as follow :—

	I.	II.
Silica..	58·45	65·1
Alumina	17·08	12·9
Ferrous oxide	4·61	4·7
Ferric oxide	0·76	2·0
Manganese oxide	trace	trace
Lime..	7·60	4·7
Magnesia	5·15	2·8
Potash	1·02	3·9
Soda..	4·25	2·8
Phosphoric acid	trace	
Water	1·07	1·9
	99·99	100·7
Specific gravity..	2·94	2·72

I.—By Mr. J. A. Phillips of stone from most westerly quarry.
II.—By T. H. W. of grey vein from the same quarry.

It would thus seem that a considerable proportion of the felspar is orthoclase. The quartz exhibits occasional fluid cavities, with spontaneously moving bubbles. In addition to these two constituents the microscope shows a number of grains of pyroxene and nests of some mineral, apparently a zeolite, forming radiating fans of crystals, which seem all to extinguish parallel to their length, and are, therefore, in all probability orthorhombic. In some cases these blades are so mixed up with quartz as to suggest a simultaneous origin for the two minerals, and the probability is, therefore, that some at any rate of the quartz is of secondary introduction. Phillips queries whether, seeing that the quantity seems to increase with the decomposition of the rock, it may not be due to the progressive crystallization of dissociated silica in the process of change. I think, however, that most of that in these grey veins must be contemporaneous with the felspar with which it is so intimately and intricately mingled.

An attempt to determine the nature of this constituent by acting on the powdered stone with acid and separating the constituents was not successful, on account of the large amount of iron which was also dissolved out, as well as on account of the decomposition products of the felspar being attacked.

In the *Neues Jahrbuch* (Beilage Band) of this year is a paper on some rocks of the Southern Black Forest, in which mention is made of certain parts where, along cracks, labradorite is changed into an intimate mixture of a more highly acid felspar, namely an albite, and a zeolite almost perfectly free from alkali. I think, however, that the appearances here are somewhat different, and the bulk analysis of the veins seems to show that this explanation will not hold good.

The greater acidity of these veins, as compared with the mass of the rock, recalls certain grey or red veins in our local Rowley Rag, which Mr. Allport has described to this Society in past years. An analysis has revealed the fact that these also are much more (9%) acid than the bulk of the rock, and moreover, that they contain about 11% of alkalis. I hope, however, to make some recent observations on these the subject of a future paper, so will not further refer to them here.

The order of consolidation, therefore, appears to be the usual one—first the more basic minerals and then the more acid, so that the magma becomes progressively more and more acid in the process of crystallization. This crystallization is accompanied by contraction, which is further increased by the contraction due to the cooling of the mass, so that the formation of cracks is quite a conceivable thing, and it would appear that the still fluid or viscous residuary portion of the mass has filled these, forming the grey veins. It has been ascertained that the glassy base of many rocks is much more acid than the total rock, as in the case of the great Cockfield Dyke, mentioned by Mr. Teall, in his paper on some north country dykes, in the "Quarterly Journal of the Geological Society" for May, 1884, where the general analysis of the rock gave 58·1 per cent. of silica, and 4·2 per cent. of alkalis, while the glassy base, when as perfectly isolated as possible, gave 70·8 silica, and 7·2 alkalis. The analysis of this dyke, as analysed by Mr. Stock, quoted by Mr. Teall, is strikingly similar to that of the rock we have under our notice to-night, except that it has apparently some 5 or 6 per cent. of alumina replaced by peroxide of iron.

As to the question what we should call the Penmaenmawr rock, we are met by the ever-recurring difficulty that, according to the German petrologists, the geological age is a factor in the question, and I do not know that any indication of the age of the mass is known. It is certainly newer than the Lower Silurian flags and grits through which it has broken its way, but no newer rocks are pierced by it, so that we have a sufficiently wide range. Assuming, however, as is probably the case, that it is at any rate pre-Tertiary, the main mass may be fairly called with Rosenbusch an enstatite diabase, for the structure is in great measure that fully crystalline one characteristic of the diabases, and the prevailing pyroxene is certainly the rhombic one.

REPORT ON MARINE SPONGES*

OBTAINED IN THE OBAN DREDGING EXCURSIONS OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY IN JULY 1881 AND 1883.

BY H. J. CARTER, ESQ., F.R.S., ETC.

1°.—Specimens collected by the dredge on board the "Curlew" in about 15-30 fths., together with others gathered on the shores of the Island of Kerrera, respectively, in 1881.

The Sponges having been separated from the other *débris* in this collection, and the species of the former from each other, they have been tied up in separate pieces of calico, numbered as follows:—

1.—*Hymeniacidon carnosa*, Bowerbank (Monograph of British Spongiadæ, vol. iii., pl. 36).

2.—*Halichondria Pattersoni*, Bk. (*Ib.*, pl. 46).

3.—*Hymeniacidon suberea*, Bk. (*Ib.*, pl. 36).

4.—*Microciona armata*, Bk. (*Ib.*, pl. 23).

5.—*Halichondria panicea*, Bk. (*Ib.*, pls. 39 and 40).

6.—*Isodictya fucorum*, Bk. (*Ib.*, pl. 56.)

7.—*Débris*, consisting of Shells, Ascidians, Polyzoa, Fuci, &c., &c.

The specimens collected from the shores of the Island of Kerrera are all of one species, viz., *Halichondria panicea*.

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* Transactions of the Birmingham Natural History and Microscopical Society. Communicated by Mr. W. R. Hughes, November 11th, 1884.

OBSERVATIONS.—*Hymeniacidon carnosa*, Bk. = *Suberites* Nardo, *apud* Schmidt, is generally stipitate, but may be simply contracted and sessile towards the base; it contains *no* flesh-spicule.

Halichondria Pattersoni may be known by its dark brown colour and spiculation.

Hymeniacidon suberea, Bk. = *Suberites domuncula*, Nardo, *ap.* Schmidt, generally grows over a gasteropodous shell tenanted by a hermit crab (*Pagurus*), and deposits its ova on the surface of the upper or remaining part of the shell (see Ann. Mag. Nat. History, 1883, vol. xii., p. 36); while it differs among other things from *H. carnosa*, in possessing the little centrally inflated flesh-spicule common also to *H. ficus*, &c. Dr. Bowerbank seems not to have noticed this, as it is omitted in his illustrations of *H. suberea* (*l. c.*) and said (vol. ii., p. 208) to be characteristic only of *H. ficus*, &c. I enclose for your acceptance some dried specimens of *H. suberea* dredged off this place (Budleigh-Salterton, S. coast of Devon), one of which has been divided vertically to show the ova, &c., *in situ*.

Of *Microciona armata*, Bk., there is only one specimen which has grown over the ventral valve of a Brachiopod (? species).

Halichondria panicea, Bk. = *Amorphina*, Schmidt, is a deep-sea as well as a littoral species, apparently the most plentiful of all, all over the world; in which the only difference appears to be in the size of the spicules which are smallest in the latter.

Isodictya fucorum, Bk. = *Halichondria fucorum*, Johnston; may be known by its habit of growing over the stems of Fuci, together with its spiculation, in which there is a little equi-anchorate flesh-spicule of the navicula-shaped kind. There is very little difference between this and *Isodictya alderi*, Bk., as I have learnt from an examination of the type specimens of these species now in the British Museum.

Of the *Débris* I can add nothing to what has been above stated.

Thus, in point of general classification, *Halichondria panicea* and *H. Pattersoni*, respectively, belong to the groups Nos. 1 and 6 in the first family of my order Holorhaphidota, viz., the Renierida (Ann. Mag. Nat. History, 1875, vol. xvi., pp. 177 and 190). *Hymeniacidon carnosa* and *H. suberea* to the second family, viz., the Suberitida. *Microciona* belongs to the Microcionina in my order Echinonemata, and here also I should be inclined to place *Isodictya fucorum* chiefly on account of the form of its skeletal spicules and the presence of the little navicula-shaped equianchorate.

2°.—Specimens collected by the dredge on board the "Aerolite" steam-launch in 15-20 fths. in 1883.

These have been treated precisely in the same way as the dredgings on board the "Curlew" above mentioned, and the species tied up separately in bits of muslin, numbered as follows:—

1.—*Hymeniacidon carnosa*, Bk.
2.—*Halichondria Pattersoni*, Bk.
3.—*Hymeniacidon suberea*, Bk.
4.—*Halichondria panicea*, Bk.
5.—*Isodictya fucorum*, Bk.

Calcareous Sponges.

6.—*Grantia compressa*, Bk., (*Op. cit.*, vol. iii., pl. 1), and *Grantia ciliata*, Bk., (*Ib.*, pl. 2,) growing together on small Fuci.
7.—*Leucosolenia botryoides*, Bk., (*Ib.*, pl. 3.)
8.—*Leucosolenia contorta*, Bk., (*Ib.*, pl. 3.)
9.—*Débris*, contents similar to those above mentioned.

Observations.—Although there is no specimen of *Microciona* here, all the rest of the species obtained in the dredging of 1881 appear in that of 1883, so that the "observations" already made on *them* are equally applicable to those of 1881.

But, in addition to these species, all of which are provided with *siliceous* spicules, there are several others here whose spicules, *minerally*, are compossed of carbonate of lime, *i.e.*, the so-called "Calcareous Sponges," of which it might be observed that:—

Grantia compressa may be known by its compressed form, smooth surface and unfringed or naked mouth, growing together on small Fuci here, with *Grantia ciliata*, from which again it may be distinguished by the rough surface and fringed mouth of the latter.

Leucosolenia botryoides, a branching little sponge, requiring the aid of a two-inch focus lens to be well seen; growing in small patches, with the ends of the branches terminating in a little sacciform head respectively; on small Fuci.

Leucosolenia contorta = *Clathrina*, Gray = *Ascetta*, Haeckel; is represented by one specimen only. It grows abundantly on the rocks between tides, at this place, and an account of it may be found in the Ann. Mag. Nat. History for 1884, vol. xiv., p. 17, under its original name of *Spongia coriacea*, Montagu.

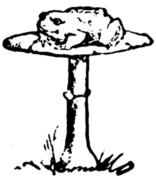
In short, all four species, with many others, may often be found growing together on the same Fucus or piece of rock.

I also enclose for the kind acceptance of the Society, a specimen, with slice to show its structure, of *Suberites Wilsoni*, a beautifully carmine-coloured sponge which occurs in pyramidal masses, sometimes upwards of fifteen inches high, on the south coast of Australia, and which, among other species, was sent to me by J. Bracebridge Wilson, M.A., F.L.S., of the Church of England Grammar School, Geelong, Victoria Colony, after whom I have named and described it.

It is sufficiently different from the *Alcyonium purpureum* of Lamarck, which also came from Australia, as I learn from the type-specimen of the latter in the British Museum, to constitute a new species, and was dredged up by Mr. Wilson, with the rest, off Port Philip Heads in about nineteen fathoms.

ON "THE STRUCTURE OF MOSSES."

BY F. T. MOTT.



Dividing the vegetable kingdom primarily into Phænogams and Cryptogams, and subdividing the Cryptogams into three classes, viz., Vascular Acrogens, Cellular Acrogens, and Thallogens, the mosses stand in the group of Cellular Acrogens, and at the head of that group. They are the most highly organised of all the purely cellular plants. Below them are the Hepaticæ, Lichens, Fungi, and Algæ; above them the vascular Cryptogams, Lycopods, Horsetails, and Ferns, and then the great host of the Phænogams.

As Cellular Acrogens they should consist of soft cellular tissue, increasing only at the growing points. But Nature draws no hard and fast lines. She is infinite and we are finite, and our attempts to map out the infinite are always baffled.

These highest Cellular Acrogens are *not* always cellular. There is in the stems of many species a central thread of narrow elongated cells approaching to fibro-vascular tissue, and the cortical cells are often thickened with woody matter so as to form a rigid bark. There is another point in which Mosses are more nearly allied to the orders above them than to those below them—this is in the phenomenon of alter-

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read February 19th, 1884.

nation of generations. The most marked distinction between alternate generations is that between the sexual and the asexual. In the very lowest forms of algæ and fungi there is no sexual generation and no alternation. All the cells are similar, and propagate by simple fission without fertilisation. In the higher forms there is a sexual generation, sometimes regularly alternating with an asexual one, sometimes coming in at more distant intervals, and sometimes there is a third generation different from either. But mosses, in common with all the vascular cryptogams above them, have an unchangeable succession of sexual and asexual generations.

The germinating spore produces a branching plant, with stem and leaves, a true cormophyte—*κορμος φυτον*—a plant with a stem. This is the sexual generation, bearing the antheridia which fertilise the archegonia. But the fertilised archegonium does not develop into a seed or a true fruit. It gives rise to a slender thread-like branch, which afterwards enlarges at the end into a thallus, on the surface of which arise spores requiring no fertilisation. This is the asexual generation. The thallus in mosses takes the form of a capsule, and is commonly called a fruit; but morphologically it is the same as the spore-bearing thallus of the thallophytes —the fungi and algæ—and not homologous with the fruit of phœnogams.

Thus in Mosses the cormophyte generation is sexual and the thallophyte asexual, while in ferns the cormophyte or stem and leaf form is asexual, the spore bearing frond; and the thallophyte—the pro-thallus, is the sexual generation bearing antheridia and archegonia.

When our present systems of classification were founded, these alternate generations were but little understood, and were not regarded. But they seem to be so fundamental to the different modes of growth and development that they will probably take a conspicuous place in the classifications of the future.

Now let us trace the various stages of growth in a moss. When a spore germinates, it produces first a branching septate thread on the surface of the ground, the cells of which contain green chlorophyll. This is called the *protonema*. From different parts of this thread leaf-buds arise, which grow at the points into stems producing leaves as they lengthen.

The leaves are sometimes distichou, that is in two opposite rows, but more often alternate and in spirals of different formulæ, which cause the leaves to stand in three, five, or eight rows.

The leaves of mosses are always sessile and broad based. In shape they vary from rounded to very narrow and pointed, but are never lobed or divided. They have no branching veins, but frequently have a midrib, sometimes two, and are often finely toothed on the edges.

The stems in one section are mostly upright and slightly branched. In another mostly decumbent and very much branched in a pinnate fashion.

These two sections are very distinct, and form well marked divisions of the order.

The upright mosses bear their fruit at the points of the stems and are called *acrocarpous*. The much branched creeping mosses bear their fruit along the sides of the stems and are called *pleurocarpous*.

Now we come to the fructification. At all times of the year there are some mosses bearing their fruits, but the spring and the autumn are the most prolific. Mosses as a rule love moisture, and they get most of it at these seasons.

Some time before the appearance of the fruit, the antheridia and archegonia are formed hidden in the axils of the leaves, or among the tuft of leaves at the top of the stem. These organs are very minute, and have only been known to exist as sexual organs within the last fifty years. They occur sometimes both together on the same plant, and sometimes each on a separate plant.

The antheridia are mostly long oval bodies filled with ciliated antherozoids which have a power of locomotion in water. The archegonia are rounded at the base and tubular above, and the antherozoids pass down the tube to reach and fertilise the oosphere.

After fertilisation the oosphere develops into a straight stalk which grows vigorously upwards, tears asunder the tube or neck of the archegonium, and carries away the top of it in the form of a cap called the calyptra. Within this cap the top of the stalk begins to swell, and gradually grows into a hollow capsule of very interesting construction. In the centre is a little pillar called the *columella*, round which the spores cluster thickly. Surrounding the mouth are one or two circlets of fine teeth called the peristome, sometimes brightly coloured, and often strongly hygrometric, opening and closing with changes of moisture in the air. Above the peristome is the lid, or moveable cover of the capsule, which has often a long beak, and which drops off when the capsule is ripe to let the spores fall out. Above the lid is the calyptra, a kind of hood or penthouse protecting the young capsule, which at last outgrows it and pushes it off, leaving the lid exposed.

The time occupied from the appearance of the antheridia and archegonia to the ripening of the spores varies from about two months to ten or twelve in different species. When the spores are ripe they have to be discharged from the capsule. This is mostly effected by the capsule bending downwards. Sometimes the stalk bends, sometimes the capsule itself becomes arched. But where the capsule remains erect a jerk is produced either by the elasticity of the peristome or by a sudden twist of the stalk, and the spores are so small and light that a very slight jerk throws them out as a fine floating dust. Then they find their way to the moist earth, and give rise to a new protonema.

Some mosses—two at least of our common species—have another method of asexual propagation, by the production of gemmæ, which are not single cells like spores, but clusters of cells produced on special stalks, and which also give rise to a protonema.

In this short sketch I have omitted many exceptions and specialities of aberrant genera, my object being merely to give a general outline of the subject by way of introduction to the examination of the living specimens.

LES PLANTES DES ALPES.*

The name of M. Correvon is already familiar to readers of the "Gardeners' Chronicle" as the writer of some useful notes on the cultivation of alpine plants, founded on an experience gained whilst curator of the Botanic Gardens at Geneva. He has now given us, in French, a small book on the same subject, containing some 260 pages of post 8vo., printed in large clear type.

The Jardin d'Acclimatation of Geneva was instituted last year, and seems likely to play an important part in the distribution of alpine plants. M. Correvon tells us that a few lovers of flowers, amongst whom he seems to have been the leading spirit, being horrified at the enormous number of alpine plants which are every year dug up in the Alps by tourists of all nations, and taken home when in full flower only to die, thought this the best remedy. "This new horticultural establishment," he says, "has for its object the raising of large quantities of the choicest alpines, to offer them to amateurs at a low price. We hope to be able to supply foreign nurserymen with these plants from seed, so they will have no more occasion to get their stock from the mountains."

After a hundred pages about the origin, and distribution, and native conditions of alpine plants, we come to the more practical part of the book, which concerns their selection and their cultivation. The flora of the Alps, we are reminded, is the richest in the world,

* Les Plantes des Alpes. By H. Correvon, Directeur de Jardin d'Acclimatation, Genève.

containing about 230 species of flowering plants, which are found nowhere else. M. Correvon estimates that out of about 900 species of flowers found in the alpine districts upwards of 700 are worth cultivating. About fifty of these have hitherto defied all attempts to tame them, but even of these M. Correvon does not despair. Perhaps half of the remainder may strictly be called mountain or rock plants, but besides these we have a catalogue of all the best rock plants in cultivation from all the mountains in the world. These are all arranged according to their botanical orders, and the soil and aspect in which each is to be planted are given. We extract two examples of the way in which the directions are given :—

Polygala chamæbuxus.—A somewhat capricious plant; sometimes it grows very well in ordinary soil, provided it has shade, whilst in other cases no care or precautions will make it grow. In general it prefers bog soil, moisture, and sunshine. I have raised it from seed, and cultivate it in light soil mixed with sphagnum.

Gypsophila repens.—Indigenous to limestone rocks, but it grows so readily that one meets with it everywhere, even on granite. It is one of the best of rockery plants; it flowers from May to November, and suits itself to all soils and all aspects. It is also a useful basket plant, because of its long hanging branches, which are very effective when loaded with flowers.

These extracts are sufficient to show the style of the book; for the cultivation of some plants we have more precise and detailed directions. All who grow alpines know how difficult a plant Soldanella alpina is—not to make grow, but to make flower, and it is interesting to read the minute details of the plan by which M. Correvon succeeded in making it flower well.

The chapters which deal with the formation of rockeries and alpine beds cannot fail to be read with interest. We are rightly told that many alpines may be grown quite as successfully in level borders as on steep rockeries, provided the conditions of drainage and soil are suitable; if the soil is heavy and wet these defects may be remedied by the bed being raised two feet above the ground level, though it is not wet, but stagnant wet, which hurts alpines. We cannot, however, entirely agree with M. Correvon in the directions he gives for the formation of a rockery, when he speaks of cementing the stones together. Stones for rockery ought to be so fitted as to interlock firmly without any possibility of their either sinking or slipping, and ought not to depend on the soil, or on mortar, for being kept in their places. There is one more point to which we would direct the special attention of those interested in the growth of alpines—the way in which old walls may be utilised for this purpose. In the concluding chapter of the work we have this subject treated of in such a way as to make us wish we could convert all our boundary walls into alpine gardens. We are told on the last page that the growth of alpines is "more a question of suitable conditions of soil than anything else," and we may say that every year's experience tends more to convince us of the truth of this maxim.—*Gardener's Chronicle.*

REGIONS WHERE CULTIVATED PLANTS ORIGINATED.

BY ALPHONSE DE CANDOLLE.

In the beginning of the nineteenth century the origin of most of our cultivated species was unknown. Linnæus made no efforts to discover it, and subsequent authors merely copied the vague or erroneous expressions by which he indicated their habitations. Alexander von Humboldt expressed the true state of the science in 1807 when he said, "The origin, the first home of the plants most useful to man, and which have accompanied him from the remotest epochs, is a secret as impenetrable as the dwelling of all our domestic animals. . . We do not know what region produced spontaneously wheat, barley, oats, and rye. The plants which constitute the natural riches of all the inhabitants of the tropics—the banana, the papaw, the manioc, and maize, have never been found in a wild state. The potato presents the same phenomenon." *

At the present day, if a few cultivated species have not yet been seen in a wild state, this is not the case with the immense majority. We know, at least, most frequently, from what country they first came. This was already the result of my work of 1855,† which modern more extensive research has confirmed in almost all points. This research has been applied to 247 species cultivated on a large scale by agriculturists or in kitchen gardens and orchards. I might have added a few rarely cultivated, or but little known, or of which the cultivation has been abandoned; but the statistical results would have been the same.

Out of the 247 species which I have studied, the old world has furnished 199, America 45, and three are still uncertain.

No species was common to the tropical and austral regions of the two hemispheres before cultivation. *Allium schœnoprasum*, the hop (*Humulus lupulus*), the strawberry (*Fragaria vesca*), the currant (*Ribes rubrum*), the chestnut (*Castanea vulgaris*), and the mushroom (*Agaricus campestris*) were common to the northern regions of the old and new worlds. I have reckoned them among the species of the old world, since their principal habitation is there, and there they were first cultivated.

* "Essai sur la Géographie des Plantes," p. 28.

† A. de Candolle, "Géogr. Bot. Raisonnée."

‡ Common Haricot *Phaseolus vulgaris*, Musk gourd *Curcubita moschata*, and the Fig-leaved gourd *M. ficifolia*.

A great number of species originated at once in Europe and Western Asia, in Europe and Siberia, in the Mediterranean basin and Western Asia, in India and the Asiatic archipelago, in the West Indies and Mexico, in these two regions and Columbia, in Peru and Brazil or in Peru and Columbia, &c. This is a proof of the impossibility of subdividing the continents and of classing the islands in well-defined natural regions. Whatever be the method of division there will always be species common to two, three, four, or more regions, and others confined to a small portion of a single country.

A noteworthy fact is the absence in some countries of indigenous cultivated plants. For instance, we have none from the arctic or antarctic regions, where, it is true, the floras consist of but few species. The United States, in spite of their vast territory, which will soon support hundreds of millions of inhabitants, only yields as nutritious plants worth cultivating the Jerusalem artichoke and the gourds. *Zizana æquatic*, which the natives gathered wild, is a grass too inferior to our cereals and to rice to make it worth the trouble of planting it. They had a few bulbs and edible berries but they have not tried to cultivate them, having early received the maize, which was worth far more.

Patagonia and the Cape have not furnished a single species; Australia and New Zealand have furnished one tree, *Eucalyptus globulus*, and a vegetable, not very nutritious, the *Tetragonia*. Their floras were entirely wanting in gramineæ similar to the cereals, in leguminous plants with edible seeds, in cruciferæ with fleshy roots. In the moist tropical region of Australia rice and *Alocasia macrorhiza* have been found wild, or perhaps naturalised, but the greater part of the country suffers too much from drought to allow these species to become widely diffused.

In general the austral regions had very few annuals, and among their restricted number none offered evident advantages. Now annual species are the easiest to cultivate. They have played a great part in the ancient agriculture of other countries.

In short, the original distribution of cultivated species was very unequal. It had no proportion with the needs of man or the extent of territory.

[The foregoing article is extracted from M. Alphonse de Candolle's admirable new book on the "Origin of Cultivated Plants"—the latest volume of the "International Scientific Series," published by Kegan Paul, Trench, and Co.—a volume of moderate size, embodying the results of much profound research, extending over many years, and containing much that is singularly interesting to botanists. We cordially commend it to all our readers, as deserving a place in their libraries.—Eds. *Mid. Nat.*]

BREAKING OF THE MERES,
SIMULATED BY AN EXCESSIVE DEVELOPMENT OF *UROGLENA VOLVOX.*

BY WM. SOUTHALL, F.L.S.

The interesting phenomena called the "Breaking of the Meres" is, I believe, usually explained as resulting from an excessive multiplication and growth of various algæ; therefore I suppose there is no direct comparison between that and the occurrence I am about to describe, which had an animal origin, but as some of the appearances were to a certain extent similar, the parallel between the two naturally suggested itself.

This apparently sudden and excessive development of one of the Infusoria occurred in a pond at Edgbaston, having the extent of about a quarter of an acre, rather deep, and nearly surrounded by trees; no stream runs into it, and it is fed by springs. It communicates with another pool at a lower level, but in dry weather the water does not run over but only percolates through the bank.

I noticed about the middle of May, 1883, that the water had assumed a deep vivid green colour, and regret that I did not examine it to ascertain the cause. Rather before the end of the month the whole of the water became almost suddenly of a light reddish brown colour, very opaque, and almost exactly like that we see in the gravel pits in this neighbourhood after a storm of rain. It had a curious effect amongst the green trees, and singularly enough the lower pool was not in the least affected, retaining its original colour and transparency. A tumblerful of the affected water showed a large population of lively swimming bodies that I at first took to be *Volvox globator*, but I was then unable to determine their proper identity. I left home on the 1st of June, and was informed that it was some weeks before the water resumed its usual appearance.

This year I looked out anxiously for a reappearance, and early in May found the same organisms were easily observed in a glass of the water. After a short time, however, they entirely disappeared, whether owing to a change of wind or temperature I cannot say, but I strained a large quantity of water without finding any. After a while the vivid green colour again showed itself in large patches, and they returned and again became pretty plentiful, but I could not connect the green colour in any way with the organisms, as their colour was a dull greenish brown. I now found that they were not plants, but animals—*Uroglena Volvox*—one of the

Infusoria. It is curious, however, to note that a number of them in a tumbler produced in the light a large crop of bubbles of gas after the fashion of submerged plants. There was not, however, much appearance of chlorophyll to account for this. I regret it was not tested to determine its nature, which I supposed at the time to be oxygen. This organism was considered to be a plant, at all events as recently as the date of the third edition of the Micrographical Dictionary, about nine years since, and I for some time looked for it amongst the algæ. I sent specimens to some of my friends for determination, but in no case did they bear the shaking undergone in carriage, having, though sent in considerable numbers, entirely disappeared in a short time. I took, however, no precautions, except filling the bottles quite full. The figure in Saville Kent's great work is correct, but hardly doing it justice and wanting in details. I observed numerous double specimens, the shape of a short old-fashioned silk purse, and which seemed to swim as freely as the globular single families.

Whether this is a species frequently met with or not I do not know; not being so beautiful as *Volvox globator*, it may not receive a comparative meed of notice; but, at all events, it seemed to me that its occurrence in countless millions, as in the present case, and the singular effects produced thereby were worthy of record.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(Continued from page 327, Vol. VII.)

CYPERACEÆ (*continued*).

ERIOPHORUM.

E. vaginatum, *Linn.* *Hare's-tail Cotton Grass.*

Native: In bogs and boggy heath lands. Rare. March.

I. Bannersley Pool! Coleshill Bog! *Bree, Purt.* i, 66, Packington! *Aylesford, B.G.*, 633. Sutton Park, abundant; marshy coppice near Packington; near Honily.

II. Shrewley Pool, *H.B.*

E. angustifolium, *Roth.* *Common Cotton Grass.*

Native: In bogs and boggy heath lands. Rather rare. April, May.

I. (*E. polystachion.*) Packington, *Aylesford, B.G.*, 633. Bogs about Polesworth, *J.P.*, *M.S. note, B.G.* Sutton! *Freeman, Phyt.*, i, 261. Sutton Park; Coleshill Pool and bog; marshy coppice near Packington; sand quarry, Cornels End; Bradnock's Marsh.

II. Near Honily Mill, *H.B.*; pool near Tile Hill Wood, 1882; Shrewley Pool.

CAREX.

C. dioica, *Linn.* *Creeping Diœcious Sedge.*
Native: On peaty and boggy heaths. Rare. June, July.
I. Abundant in Sutton Park; marshy heath land, Ballard's Green, near Arley.
II. Styvichall Pool, *T. K.*, *Herb. Perry.*

C. pulicaris, *Linn.* *Flea Sedge.* *Harpoon Carex.*
Native: On boggy and damp peaty heaths. Rare. June, July.
I. Sutton Park, abundant; Ballard's Green, near Arley; Cornel's End.
II. In some marshy ground near Rugby, *Purt.*, ii, 441; banks of canal near Hill Moreton Locks, *R. S. R.*, 1880.

C. disticha, *Huds.* *Soft Brown Sedge.*
Native: In damp pastures, and near pools and rivers. Local. June, July.
I. Honily, *Y. and B.;* Sutton Park, rare; abundant in Water Works Ground, Witton Lane; by the Cole, near Coleshill Mill; Bradnock's Marsh.
II. In a thicket in the road from Dunnington to Abbott's Moreton, *Purt.*, ii, 442; near Chesterton; Rounsel Lane; Hill Wootton, *Herb. Perry;* Blue Boar Lane, and near Cosford, Rugby, *L. Cumming;* Rowington Canal Bank; marshy heath land, near Sowe Waste Canal.

C. teretiuscula, *Good.* *Lesser Panicled Sedge.*
Native: In spongy bogs. Very rare. June, July.
"38. Warwick. Kirk. Cat." *Top. Bot.*, 437.
Var., *b. Ehrhartiana*, Hoppe. Very rare.
I. Sutton Park, very abundant, 1883-4.

C. paniculata, *Linn.* *Greater Panicled Sedge.*
Native: Near rivers, canals, pools, and in damp woods. Locally common. May to July.
I. Sutton Park, abundant; canal side near Curdworth; Water Works Ground, Witton Lane; Marston Green; Olton Pool; Henfield, near Knowle; canal bank, near Temple Balsall; Knowle Canal bank; Bradnock's Marsh; Earl's Wood.
II. Honily; Radford, *Y. and B.;* Bearley Bushes; Hatton Canal; Binley Common; canal, near Newbould-on-Avon; Farnborough.

C. vulpina, *Linn.* *Great Sedge.*
Native: In ditches, marshes, and damp meadows. Common. May to August. Area general.

C. muricata, *Linn.* *Greater Prickly Sedge.*
Native: On banks, near canals, waste heathy spots, &c. Common. May to July. Area general.
b. pseudo-divulsa. Rare.
II. Near Haywoods.

C. divulsa, *Good.* *Grey Sedge.*
Native: On banks and heathy roadsides. Local. May to July.
I. Near Blythe Hall, Coleshill; Bannersley Rough; heathy roadsides, near Barston Marsh; heathy waysides, Blythe Bridge, near Solihull.
II. Harbury, *H. B.;* on a hedge bank between Wixford and Pophills, *Purt.*, ii, 413; Honington, *Newb.;* Iron Cross, near Wixford; Salford Priors; Red Hill, near Alcester; near Morton Bagot; Little Alne; Aston Cantlow; Studley, near the railway station; Baddesley Clinton.

C. echinata, *Murr.* (*C. stellulata*, Good.) *Little Prickly Sedge.*
Native: In bogs, marshes, and damp woods. Local and rare. May to August.
I. About Middleton! *Ray, Cat.*, p. 150; Coleshill Bog! *Ick. Anal.*, 1837; Bradnock's Hayes, near Little Sutton; School Rough, Marston Green; Coleshill Pool; pasture by Olton Pool; Hill Bickenhill; sand quarry, Cornel's End; near Berkswell; damp pastures, near Packwood Mill; Earl's Wood; Forshaw Heath.
II. Haywoods!; Milverton, *Y. and B.*; marsh on Binley Common.

C. remota, *Linn.* *Distant-spiked Sedge.*
Native: On damp banks by ditches, drains, &c. Common. June, July. Area general.

C. axillaris, *Good.* *Axillary Sedge.*
Native: In damp copses and on damp banks. Rare. May to July.
I. Abundant in an osier plantation near Solihull, 1872-8; abundant on damp banks near Hampton-in-Arden, 1881; near Kingsbury Railway Station, lane to Hurley, 1883.
II. Near Rounsel Lane, Kenilworth, *H. B.*, *Herb. Brit. Mus.* Extinct. In abundance near Ansty, Coventry, 1883.

C. Boenninghauseniana, *Weihe.* *Bönninghausen's Sedge.*
Native: In bushy pits. Very rare. July.
II. Bushy pit near Rounsel Lane, Kenilworth, *H. B.* Extinct.

C. elongata, *Linn.* *Elongated Sedge.*
Native: On damp hedge banks. Very rare, June, July.
I. Abundant in several places near Hampton-in-Arden; abundant in pool near Birchey Leasowes, Shirley.

C. canescens, *Linn.* (*C. curta*, Good.) *White Sedge.*
Native: In boggy meadows, near pools, and on damp banks. Very local. May, June.
I. In a pool not far from Middleton towards Coleshill, *Ray, Cat.*, ed. 1, p. 147; Sutton Park, near several of the pools; on the shores of Coleshill Pool; marshy meadow near Earl's Wood, abundant, 1883.

C. leporina, *Linn.* (*C. ovalis*, Good.) *Oval-spiked Sedge.*
Native: In turfy bogs, damp heathy roadsides and pastures. Common. May, June. Area general.

C. stricta, *Good.* *Tufted Sedge.*
Native: "Water sides and in marshy places. Not uncommon. April.
At Pophills on the side of a ditch near to the River Arrow," *Purt.*, iii, 556. "38, Warwick, Kirk. Cat," *Top. Bot.*, 440.
I have not seen this plant in any Warwickshire locality.

C. acuta, *Linn.* *Slender-spiked Sedge.*
Native: Near rivers, canals, and pools. Very local. June, July.
I. Banks of the Blythe, Bradnock's Marsh; near Righton End; Barston Marsh; Temple Balsall; Blythe Bridge, near Solihull.
II. Blacklands, near to Oversley Bridge, *Purt.*, ii, 451. Binley, *T. K.*, *Herb. Brit. Mus.* Chesterton, *Y. and B.* Chesterton Mill Pool! *H. B.* River Avon, near Stratford! *H.B.* In a stream near Newbold and near Stanford Hall, *R. S. R.*, 1877; by Swift at Brownsover, by Brandon Wood, *L. Cumming*; canal near Yarningale Common; canal near Rowington.

C. Goodenovii, *Gay.* (*C. vulgaris*, Fries.) *Common Sedge.*
Native: In bogs, marshes, damp pastures, and roadsides. Common. April to June. Area general.

There appear to be more than one distinct variety of this common species, which I think deserve closer study than I have yet given to them.

C. glauca, *Scop.* *Glaucous Heath Sedge.*
Native: In dry heathy pastures, on heathy roadsides, and in quarries. Common. April to July. Area general.
b. Micheliana, Sm. Rare.
II. Wyken Colliery. "Teste Borrer." *T. K.*, *Herb. Perry.* Wyken Rumps. *T. K.*, 1855, *Herb. Brit. Mus.*
C. glauca is not only widely spread, but also differs remarkably in character, and deserves more attentive study than has been as yet given to it.

C. pilulifera, *Linn.* *Round-headed Sedge.*
Native: In woods, and on heaths and heathy roadsides. Very local. May, June.
I. Sutton Park; Chelmsley Wood; School Rough, Marston Green; Coleshill Heath; Ballard's Green, near Arley; Earl's Wood, in several places; Forshaw Heath.
II. Yarningale!; Haywoods, *Y. and B.;* spinney, near Rugby, *R. S. R.*, 1880.
A form approaching *C. Leesii*, Ridley, occurs with the type on Coleshill Heath.

C. præcox, *Jacq.* *Vernal Sedge.*
Native: On heaths, heathy roadsides, and turfy banks. Rather local. April to June.
I. Sutton Park; Middleton Heath; Coleshill Heath; near Chelmsley Wood; Marston Green; near Sheldon; Olton Reservoir; Earl's Wood Reservoir; Forshaw Heath.
II. Kenilworth, frequent, *Y. and B.* Yarningale Common; Shrewley Heath; near Haywoods, &c.

C. pallescens, *Linn.* *Pale Sedge.*
Native: In woods, damp pastures, and damp roadsides. Locally abundant. May, June.
I. Middleton! *Ray*, *Cat.*, ed. 1, 144; Honiley! *Y. and B.* New Park Middleton; Hartshill Hayes; Kingsbury Wood; damp pastures near Solihull Railway Station; Wheyporridge Lane, near Solihull; damp pastures near Knowle Railway Station; pastures near Lapworth Church; road sides near Earl's Wood.
II. Oversley Wood,! *Purt.*, ii, 447. Drayton Bushes; pastures near Wroxall; wood near Tile Hill Railway Station; Combe Woods; Prince Thorpe Wood, 1870, very abundant.

C. panicea, *Linn.* *Pink-leaved Sedge.*
Native: In turfy bogs, on damp heaths and damp roadsides. Rather common. May, June.
I. Coleshill Bog; *Ick. Anal.*, 1837; Sutton Park; Middleton Heath; Trickley Coppice; Hartshill Stone Quarries; Whitacre Heath; Earl's Wood.
II. Beausale Heath, *Y. and B.* Roadsides near Stratford-on-Avon, Chesterton, &c.

C. pendula. *Huds.* *Great Pendulous Sedge.*
Native: In damp woods and woody places, and in drains. Locally abundant. May, June.
I. Maxtoke; Shustoke; Arley Wood; Hampton-in-Arden; Kingsbury Wood; Bentley Park; Spring Coppice, Hockley.

II. Oversley Wood! Spernal Park, *Purt.*, ii, 444; Honily, *Y. and B.;* Waverley Wood, near Rugby, *L. Cumming;* Seas Wood, Arbury; Combe Woods; Tile Hill Woods; Baddesley Clinton; Rowington Canal Bank; Kingswood; Bearley Bushes; Aston Cantlow; Henley-in-Arden; Moreton Bagot, &c.

C. sylvatica, *Huds.* *Pendulous Wood Sedge.*

Native: In damp woods, and in damp pastures. Locally abundant. May, June.

I. Tumble Hole, near Shustoke; Hartshill Hayes; Bentley Park; Kingsbury Wood; Drakendge, near Hurley; woods at Escole's Green; damp pasture near Solihull Railway Station; Spring Coppice, Hockley; woods near Earl's Wood.

II. Kenilworth, *Y. and B.;* Honington, *Newb.;* Alveston Pastures; Oversley Wood; Drayton Bushes; Aston Cantlow; Bearley Bushes; Haywoods; Tile Hill Woods; Combe Woods; Prince Thorpe Wood; Chalcote Wood, Umberslade; Moreton Bagot.

C. lævigata, *Sm.* *Smooth-stalked Sedge.*

Native: In shady wet places. Rare. June, July.

I. Sutton Park.

II. Harbury Railway cutting; Fosse Road, near Harbury; Sitch Fields, Chesterton, *H. B.;* spinney, near Rugby, *R. S. R.*, 1880.

C. binervis, *Sm.* *Green-ribbed Sedge.*

Native: On damp heaths, heathy roadsides, damp woods and pastures. Locally common. June, July.

I. Sutton Park; Middleton Heath; Coleshill Heath; Bannersley Rough; Little Hell, near Honily; Forshaw Heath, Tanworth.

II. Oversley Wood; Drayton Rough Moors; Alveston Pastures; Haywoods; Combe Woods.

Not recorded by Purton. Possibly his *C. distans* is referable to this species.

C. distans, *Linn.* *Distant-spiked Sedge.*

Native: In turfy, brackish bogs. Rare. June, July.

II. Oversley; Coughton, *Purt.*, ii, 445. Near Harborough-Magna, *Rev. A. Blox.* Itchington! Chesterton! *Y. and B.* Southam Holt, *H.B.!* Inland form about Honington; Tredington; a plant of the district in suitable places, *Newb.* Itchington Holt; marshy places in Alveston Pastures; boggy land near the Avon. Binton Bridges.

C. fulva, *Good.* *Tawny Sedge.*

Native: In shady, turfy bogs, and marshy places. Very rare. June.

I. Sutton Park; abundant in 1875, but now almost exterminated by the railway workings and drainage.

II. Near Stivichall, *T. Kirk.*

C. flava, *Linn.* *Yellow Sedge.*

Native: In bogs and marshes. Very local. May, June.

I. North end of Sutton Park; Bannersley Pool; marshy coppice, Hill Bickenhill; roadsides near Earl's Wood.

II. Snitterfield Bushes; Oversley, *Purt.*, ii, 445; Hill Wootton, *H. B.;* Milverton, *Y. and B.;* Rowington.

b. lepidocarpa, Tausch. Local, often occurring with the type.

I. Sutton Park, very abundant; Middleton Heath, Baxterley Common; Ballard's Green; Bannersley Pool; marshy coppice, Hill Bickenhill; Coleshill Pool; Marston Green; sand quarry, Cornel's End; damp pasture, Olton Pool; Shirley Heath; Earl's Wood Reservoir; Forshaw Heath.

II. Haywoods; Kenilworth Heath; Yarningale Common, *B. H.;* Chalcot Wood, Umberslade.

Both these varieties have been compared with specimens received from the late H. C. Watson with which they agree truly, but the var. *lepidocarpa* of all the districts recorded by myself would be included under *C. flava* var. *minor* (Townsend, Journ. Bot., x, 163, June, 1881).

C. hirta, *Linn.* *Hammer Sedge.*

Native: In meadows and damp places, Locally abundant. May to July.

I. Stew at Edgbaston, *With.*, ed. 7; Sutton Park; Middleton Heath; roadsides near Coleshill; Cornel's End; Bradnock's Marsh; Henfield; Knowle; Solihull; Packwood.

II. Honily, *H. B.*; Honington; Tredington, *Newb.*; Alveston Heath; Binton Bridges; Drayton Bushes; Chesterton Mill Pool; Sowe Waste Canal; Brinklow; Brandon; canal near Newbold-on-Avon; Combe Pastures; Ansty, near Coventry, &c.

(To be continued.)

Reviews.

A Short Hand-book of Natural History. CHESTER. 1884.

THIS pamphlet, which is published by the Chester Society of Natural Science, for use at the Annual Conversaziones and other meetings of the Society, contains a very good but brief account of the two biological kingdoms, a few words at the end being devoted to the mineral kingdom, the polariscope, and the spectroscope. It seems to be founded upon that published in 1882 by the Birmingham Natural History and Microscopical Society, but has been greatly enlarged and improved.

The authors state that they have adopted the classification which they deemed most likely to be known. But that with which they begin the Vegetable Kingdom (p. 4) viz., the arangement of the Fungi and Algæ in two parallel series (due to Sachs), while it scarcely seems to fulfil the condition which they impose, has lately suffered a curious fate. The philosophers of that happy land across the Rhine, who so obligingly furnish us with new classifications *ad infinitum* at frequent intervals, have now thrown it overboard again, even its author concurring in its rejection. It is at present a high crime and misdemeanour in the centres of English biological (at any rate, botanical) teaching, to venture to differ from the latest German authorities on any point, the only difficulty being to make oneself quite sure which is the latest. This classification of the two allied groups will therefore now probably disappear from our books—a fate much to be regretted, because it has a good deal to recommend it, although one class, the "Carposporeæ," is about the most heterogeneous group of forms that the perverted ingenuity of a systematist ever within recent times brought together.

It is much to be wished that our writers would give up the mistaken application of the name Torula (p. 4) to the common yeast and various yeast-like forms. Torula is in the eyes of the mycologist a well-marked genus belonging to a widely different group. The

Myxomycetes (p. 6) are not now included among the Zygosporeæ, it being at last recognised by our German friends that the "analogy" of the plasmodium to a zygospore existed only in a distorted imagination. The ungrammatical "and which" on the same page (line 19) makes the sentence bear a meaning that is not intended. It is nearly time, moreover, that British cryptogamists learned to call the formation of new plants by ordinary vegetative growth by the name of "multiplication," confining the term "reproduction" to the cases in which some act of sexual union actually or presumably takes place. The English student who reads that the spores formed within the sporangium of Mucor are called "conidia" (p. 6) will probably stare with surprise, although in so naming them the authors are in accordance with the very latest German dictum. The genus *Micrasterium* (p. 5) would be a new one to most collectors of Desmids. Again, the statement (p. 9) that the "Rust of wheat, *Æcidium berberidis*," is "also known as *Puccinia graminis*," is very misleading; it is easy to present the facts in a way which will convey to a layman the meaning intended, but certainly not expressed.

The Equisetineæ (p. 12), which ought to be placed after the Filicineæ, possess, equally with the other Vascular Cryptogams, both isosporous and heterosporous forms, the latter being represented by the fossil Annulariæ and possibly by Asterophyllites. Despite a few errors of this kind the book is a useful and readable one, the chief distinctions between the various classes and subdivisions of animals and plants being described with remarkable clearness, and the examples of each, taken from the Chester district itself, being numerous and well chosen. W. B. G.

The British Moss Flora. By R. Braithwaite, M.D., F.L.S., &c. Part VIII. Fam. VIII. Tortulaceæ I. Small 4to.; 6s. The Author, 303, Clapham Road, S.W.

However bryologists may differ in their views of classification and nomenclature from the author of this elegant work, I am convinced that all will agree in ascribing to him the highest praise for his power as a delineator and for his clearness as a descriptive botanist. The present part contains six plates, with illustrations of forty-two species, and the text embraces descriptions of the various species belonging to the genera *Ephemerum, Acaulon, Phascum, Pottia*, and part of *Tortula*. Both the illustrations and descriptions are excellent, and make one wish that so valuable a work could make more rapid progress. With regard to the classification the author remarks, "This widely distributed family, so rich in species—for it includes probably not less than 800—is a most difficult one to deal with, and has taxed the ingenuity of every bryologist to arrange the species in well-defined genera. The variations in habit, colour, and leaf structure afford more stable ground for generic characters than the peristome, and this was first advocated by Mr. Mitten in his *Musci Indiæ Or.* (1859); but there has been an indisposition to break up the great genus

Tortula resting solely on the twisted peristome, but combined with a variable structure of leaves; and still stronger was the objection to admit gymnostomous species as congeners with the peristomate ones, although no mosses more clearly exhibit the weakness of this distinction than some of the old *Gymnostomums* now referred to *Pottia*, and the genus *Anacalypta*. Lindberg, in his *Musci Scandinaviæ*, has fully carried out the modern views, and I can only advise all bryologists to study the plants themselves under this newer aspect, feeling assured that they will soon appreciate the soundness of a natural classification." (Page 181.) With these remarks I fully agree, and am convinced that the only natural arrangement that is likely to be lasting must be one in which the cell structure of the leaves takes a prominent part. How far the nomenclature adopted by the author will be accepted by British bryologists it is impossible to predict, but a careful study of the long lists of synonyms will show that the author's desire to do justice to the original authorities has been strictly followed out throughout the work. Part IX., which will conclude the Family VIII., Tortulaceæ, and also complete Vol. I. of this work, is promised for the early part of next year. J. E. BAGNALL.

The Fungi of Norfolk. BY CHARLES B. PLOWRIGHT, M.R.C.S. Demy 8vo., pp. 21, 1884.

THE investigation of the Fungus Flora of Norfolk appears to have been first commenced by the Rev. G. Munford, who, in 1864, published a list of seventy-two species found in the county. This botanist was afterwards followed by the present author, and so ably that in 1872 he was able to communicate to the Norfolk and Norwich Naturalists' Society a list of nearly eight hundred species. To this, during the twelve years that have since elapsed, eight hundred more species have been added, so that the present list comprises nearly sixteen hundred species. This is one of the most comprehensive county lists of Fungi that has as yet been published, and does great credit to the industry and scientific ability of the author.

In addition to the list of Fungi there is a "Note on the Classification of the Sphæriaceæ," in which the system adopted by Prof. Saccardo is ably expounded.

The assistance is acknowledged of Canon Du Port, Mr. Frank Norgate, and Mr. J. Harvey Bloome. J. E. BAGNALL.

Norfolk Broads and Rivers. By G. C. DAVIES. Second edition. 8vo., 328 pp., 7 plates. W. Blackwood and Sons.

MR. DAVIES'S book contains the best description of the water-ways of East Anglia with which we are acquainted. While he appeals specially to the sympathies of the yachtsman and the angler, there is much—very much—of deep interest to the naturalist. The account of the decoys—to which three plates are also devoted—is valuable, because it appears that owing to the improved drainage this interesting method of catching wild-fowl will before long have passed out of use. The accounts of holidays spent on the Broads in summer, in a little centre-board yacht, are very tempting, and will, we fancy, lead many to follow the author's example. W. J. H.

Phillips's Manual of Geology. Vol. I. Physical Geology and Palæontology. By H. G. Seeley, F.R.S. 8vo., 546pp., 147 woodcuts and coloured plate. Price 18s. C. Griffin and Co.

The last edition of Prof. Phillips's valuable work was published in 1855, and the progress of science since that date has been so great that the book, the title of which appears at the head of this notice, is practically a new work. It is a work on which Prof. Seeley has expended great labour, and from a careful study of its contents we can say that it will prove a most valuable book of reference for students of geology—British geology especially. The introductory chapters deal with the origin of geology and the earth; minerals have one chapter allotted to them, while rocks require four. Volcanic rocks—ancient and modern—are treated of in great detail, while the chapters on "Coast Lines and their Origin," and on the "Relation of Scenery to Geological Phenomena," are of great interest for even the general reader. Two chapters are devoted to an introduction to Palæontology. Those who know the valuable work which Prof. Seeley has done at Cambridge and in London, together with the ripeness and catholicity of his knowledge, will be pleased to possess this book, which contains much that is both new and true, while the old truths on which the science of geology rests are set forth with simplicity and accuracy. The illustrations are well conceived and telling. W. J. H.

THE MICRO-VEGETATION OF BANK NOTES.*

The recent researches of Paul Reinsch in Erlangen have revealed the occurrence, on the surfaces of the coins of many nations, of different bacteria and two minute algæ (Chroöcoccus monetarum and Pleurococcus monetarum, P. Reinsch), living in a thin incrustation of organic detritus composed especially of starch-grains, fibres, &c., deposited upon their surfaces during the course of long circulation. This thin incrustation renders the coins very suitable for this micro-vegetation, but the same phenomenon is exhibited by paper money, and, indeed, by notes of clean and, to the naked eye, unaltered surface.

I have scraped off some of these minute incrustations with hollowed scalpels and needles, and divided them into fragments in distilled water that had been boiled shortly before, and, upon examining them with lenses of high power (R. T. Beck's 1-10th inch), have seen the various Schizomycetes distinctly.

* *The Micro-vegetation of Bank Notes.* By Dr. Jules Schnarschmidt, Privat-docent of Cryptogamic Botany and Anatomy of Plants, Assistant of the Botanic Institutes and Royal Gardens, Hungarian University, Kolosvár.

I can now proceed to give a brief account of the results I have obtained from the investigation of the paper money. I have investigated the Hungarian bank and State notes, recent and old (from the years 1848-49), also Russian rouble notes, and have found bacteria upon all of them, even upon the cleanest.

On the surface of all the paper money is always to be found the special bacterium of putrefaction, viz., Bacterium Termo, Dujardin.

In the thin incrustations on the paper money I ascertained the occurrence of starch-grains (especially those of wheat), linen and cotton fibres and animal hairs, and, in this deposit upon the florin State notes, the Blastomycete, Saccharomyces cerevisiæ, in full vegetation.

Various Micrococci, Leptotriches (many with club-shaped, swollen ends), and Bacilli are also the most frequent plants in the deposit on the paper money.

The two new species of algæ described by Paul Reinsch are very rare on paper money. The green pleurococcus cells have been observed in some cases on 1 and 5 florin State notes, and the bluish-green minute Chroöcoccus on the border of the 5-florin State notes.

The vegetation of the paper money is, according to my researches, composed of the following minute plants:—

1. Micrococcus (various forms); 2. Bacterium Termo; 3. Bacillus (various forms); 4. Leptothrix (species?); 5. Saccharomyces cerevisiæ; 6. Chroöcoccus monetarum; 7. Pleurococcus monetarum. From a hygienic point of view, an investigation of the commonest household objects, and especially of books, &c., used by students may not be superfluous.—*A. K., Klausenburg, Hungary, in "Bulletin of the Torrey Botanical Club."*

METEOROLOGICAL NOTES.—NOVEMBER, 1884.

Barometric pressure was very unsteady throughout the month, and consisted of a series of fluctuations between 29·6 inches and 30·5 inches. The mean was, however, above the average. Temperature was about the average. The range was greatest at the commencement of the month, least in the middle. On the 14th the range did not amount to 3 degrees. The highest maxima observed were 59°0 at Coston Rectory, on the 2nd; 58°6 at Hodsock, on the 1st; 58°2 at Loughborough, on the 2nd; 57°1 at Strelley, on the 1st; and 57°0 at Henley-in-Arden, on the 5th and 7th; 101°2 was recorded at Hodsock in the rays of the sun, and 98°5 at Loughborough, on the 9th. The lowest minima occurred on the 30th, and were 20°0 at Coston Rectory; 21°0 at Henley-in-Arden; 21°8 at Hodsock; 22°1 at Loughborough; and 23°3 at Strelley. On the same date, the thermometer exposed on the grass, registered 17°9 at Loughborough; 18°1 at Strelley; and 19°5 at Hodsock. The rainfall was again decidedly below the average, especially in the East Midlands, where the amount in no case reached 1½ inches. At Henley-in-Arden the total value was 2·20 inches. Snow fell on the 30th. The prevailing winds were westerly, and generally light in force. Sunshine was deficient. Much inconvenience has been occasioned in several districts through the scarcity of water.

WM. BERRIDGE, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

A Fungus Foray.—If Mr. Bagnall will refer to former volumes of the "Midland Naturalist" he will find *Ag. ditopus* recorded in the volume for 1883, pp. 264, 272, and *Ag. furfuraceus* in the volume for 1882, p. 184.—W. B. G.

Anker Flora.—About the middle of last month (November), in company with Mr. E. De Hamel, of Tamworth, I had a short botanical walk over Warwickshire Moors, Rye Hills or Royals, by Rimington Hall, and so back to Tamworth. Much of the ground we went over is moorish pasture land, drained by the River Anker, and numerous tributary streams. The season was too late for me to form a true estimate of the floral riches of the district, but from what I was able to identify I should think the flora of this river basin would be found to be both rich and varied if the ground were well worked earlier in the season. During our walk I took notes of all that could be still recognised, and found when I reached home that we had observed over 126 species, representing 88 genera and 38 natural orders of flowering plants, and several very local mosses. Among the plants recorded two are new as records for the Tame basin, viz.: *Œnanthe fluviatilis* and *Potamogeton densus*, and the following are species that I consider noteworthy:—Ranunculus circinnatus, R. fluitans, Callitriche obtusangula, C. hamulata, Helosciadium inundatum, *Œnanthe fluviatilis*, Tanacetum vulgare, Veronica polita, V. Anagallis, Lemna gibba, L. trisulca, Acorus calamus, Potamogeton serratus, *P. densus*, Zannichellia palustris, Sagittaria sagittifolia, Butomus umbellatus, Agrostis nigra, Phragmites communis, Glyceria aquatica, Chara fragilis. The more noteworthy mosses are:—Tortula latifolia, Fontinalis antipyretica, Leskea polycarpa, Scleropodium cæspitosum.—J. E. Bagnall.

Only a dead Spider.—I fancy I hear many say—"Well, what is there extraordinary in a dead spider; throw it away, the nasty horrid thing; I hate all spiders." But I am glad to say that this particular dead spider, and the lesson learned from it, has not been thrown away upon one human being at any rate, and I write these few lines hoping that others may have their hearts touched and rebuked. A short time ago I had occasion to visit a grocer's shop, when one of the assistants (knowing my love for all creeping things) said—"Oh, Mr. ——, we have got a great big dead spider for you which we found some time ago at the bottom of a tea chest which had just been emptied." On examining the specimen, I found it to measure over four inches across its legs, the head or cephalo-thorax being half an inch long, the abdomen shrivelled up, but grasped tightly within its jaws was a large round and flat cocoon of eggs, one inch diameter. This latter fact at once gave me an idea as to what family it belonged, viz., the Lycosidæ, of which we have in Great Britain between thirty or forty representatives, all of which are in the habit of carrying about with them their cocoon of eggs, grasping it firmly with their powerful jaws, besides having a silken cord attached to it from their spinners. On a warm, sunny day in June I have often seen thirty or forty specimens of *Lycosa agretica*, males and females, basking in the sun on an old box, tin pot, or broken piece of pottery lying about near a hedge, at the approach of anyone running and hiding away underneath stones and among the dry herbage at the bottom of the hedge, waiting until all danger is past. But if the intruder on their peace attempts their capture, they do, indeed, run for their lives, dodging in and out, taking advantage of every nook and cranny wherein they can hide, so as to avoid detection, and just as the entomologist makes a pounce upon one, it makes another effort to escape capture by running through the rank grass, when suddenly it stops in its rapid retreat, and actually turns back! as if in seach for something, apparently having lost all desire to escape, moving slowly and carefully, when all at once it starts off again as if filled with new life, and as often as not succeeds in reaching a place of safety at the bottom of a thorny hedge. What is the cause of all these strange changes in its behaviour? The poor spider has not been running to save its own life only, but for the safety of its precious cocoon of eggs, and its sudden stop was caused by having its load rudely jerked from its grasp as it was running through the coarse grass, and then it was that it seemed to care so little for its own safety, but as soon as it had regained its treasure, then all its energy was renewed, and nothing would induce the spider to part with its cocoon. Such is a rough sketch of one of our indigenous spiders, to which family this big dead one belonged; it had, no doubt, been basking on the sides of an empty tea chest, when a "Heathen Chinee" came along and emptied his load in, smothering the poor spider, which might have effected its escape had it not been encumbered by its load of eggs, no mean hindrance to its free movement when buried in the tea; but rather than loose its hold and escape, it, like the standard bearer, held on with the grasp of death. Surely we mortals can learn something from the affection displayed by this spider, and perhaps the heart of some brother naturalists may be touched in a practical manner at this time of year, when there are thousands of poor little half-starved waifs and strays who have never had the parental affection shown to them such as "only a dead spider" showed to its offspring as long as life lasted, and, "being dead, yet speaketh."—A Lover of Spiders.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, December 2nd.—Mr. W. B. Grove, B.A., read a paper on "New or Noteworthy Fungi," part 2, which was illustrated by numerous and beautifully-executed microscopical drawings. He described several species new to science, and a large number new to Great Britain, and nearly all collected in this district. Biological Section, December 9th.—Mr. W. P. Marshall in the chair. Mr. T. Bolton exhibited *Nais hamata*, a worm described as a new species last year by Professor Tims, of Wurzburg. Also the larva of the Fairy Shrimp, *Cheirocephalus diaphanus*, and mounted specimen of a very rare entomostracan, *Lynceus acanthoceroides*, both from near Bewdley. Mr. W. H. Wilkinson: Lichens, *Physcia parietina*, *Peltigera horizontalis*, *P. rufescens*, *Evernia furfuracea*, *Ramalina fastigiata*, *Usnea barbata*, *Alectoria jubata*, *Lecanora atra*, and other lichens from Scotland. Also the Kilmarnock Willow, a pendulous variety of the common Goat Willow, *Salix caprea*, from the banks of the River Ayr, in Scotland. Professor Haycraft, M.B., then read his paper on "Some New Observations upon the Physiology of the Medicinal Leech," *Hirudo medicinalis*, illustrated by a large diagram, black board illustrations, and a series of specimens under the microscopes. Professor Haycraft described some experiments performed by him in the Physiological Laboratory of Mason College. He had found that the medicinal leech secretes from its sucker and gullet a juice which has the peculiar property of preventing the coagulation of blood. This juice can be extracted with water, and if the extract be added to blood, freshly drawn, this remains permanently fluid, instead of clotting in the usual way. The coagulation of blood is due to the formation of a substance called fibrin, by the action of a specific ferment. This latter is destroyed by the leech extract. On invertebrate blood, when the clotting is due to another cause, the secretion has no action. From experiments which he had recently performed in Germany, the Professor found that an extract of three or four leeches, injected into veins of a living dog or rabbit, produced well marked fluidity of the blood, and other symptoms more interesting to the physician than to the naturalist. In the leech's own economy the juice plays an important part. As is well known, the blood "sets" in a solid mass around the edges of an ordinary wound—say that produced by a razor cut. This stops the continuous bleeding which would otherwise follow. Now but for this juice, which flows from the sucker into the wound when the leech bites, the creature would suck in vain. After the first few drops had exuded no more would flow, and that which had passed into its gullet would set into an indigestible clot. One can now explain why, when the leech is removed, the wound continues to bleed often for a very long time; its edges are impregnated with the juice, and clotting only occurs when this has been all washed away.—A discussion followed, in which the Chairman, and Messrs. W. R. Hughes, R. W. Chase, T. Clarke, France, Cullis, and others took part. Professor Haycraft also presented to the Library of the Society a copy of his paper as read before the Royal Society. MICROSCOPICAL GENERAL MEETING, December 16th.—Mr. C. Pumphrey exhibited, by the aid of the lantern, a series of photographs taken by him during his journey and visit to Canada and America. The first was a view of the Liverpool Docks, then several pictures taken on board the steamship "Vancouver" during the voyage to Quebec, such as groups of passengers, some in repose, others occupied in games to pass away the time; then waves and icebergs. On arriving at Quebec Mr. Pumphrey did not go on to the meeting of the British Association, but made his way to the Yellowstone Park, a large tract of land about sixty miles square, set apart by the Americans as a park for ever; it is reached by a southern branch on the North Pacific Railway. He also exhibited several views taken on the way, such as an Indian town with its wigwams, the city of Winnipeg, interior of a Pulman car, and interior of a dining saloon in a steamboat on Lake Superior. Arriving at the Park there was the Mammoth Hotel, containing a thousand beds, and another hotel, which was composed of canvas tents only. Views were given of the hot springs, showing the peculiar shapes assumed by the tufa, formed by the lime from the hot water; also views of the geysers, showing how they deposited siliceous matter; but the grandest views were those taken of the great cañon, or ravine, which is about one thousand feet deep, and at the top one mile wide. Through this the Yellowstone River runs, and in one part it falls three hundred and fifty feet. Here the scenery is grand, and Mr. Pumphrey has obtained several good pictures. The exhibition was very interesting and instructive, and as only half the pictures were shown the members will have an opportunity of seeing the others on some future occasion.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION. - November 17th.—Mr. Madison exhibited various specimens of foreign Helices. Under the microscope the following objects were shown: by Mr. Moore, antennæ of *Volucella plumata;* Mr. Darley, larva of *Ephemera marginata;* Mr. Tylar, an electro-deposit of Silicon resembling a chain diatom; Mr. J. W. Neville, a palate of *Fusus Islandicus*. Mr. Betteridge then contributed his third paper on the "Birds of the District." November 24th.—A Lecture was delivered by the President, Mr. C. Beale, C.E., on "What is under us," in which he described the surface beds from the place of meeting, through Deepfields, to Sedgley Beacon; from this point the Lecturer dealt with "What is under us." The Silurian rocks were described in their descending order: the arrangement of the beds of the upper, middle, and lower Ludlow and Wenlock formations, the circumstances under which they were deposited and the forms of life most prevalent and peculiar to each. The formations of Cambrian age were next described as rocks in which the traces of life could still be made out, and the Laurentian, of which only an inconsiderable portion was found in this country. In the Pre-Cambrian rocks the records of life were nearly obliterated, and the few found only of the lowest kind. The lecture concluded by assigning reasons for the great antiquity of the earth—an antiquity altogether beyond human comprehension, and pointing out that, notwithstanding the diligent researches made in geology, we are as yet only on the border-land of knowledge. The lecture was illustrated by a beautifully drawn section of the earth's crust and some of the rarer rocks and fossils. December 1st.—Mr. Hawkes exhibited the following fungi: *Lecythea euphorbiæ, Coleosporium senecionis, Puccinia variabilis, Puccinia lychnidearum*, and *Puccinia sonchi*, the latter pronounced by Mr. W. B. Grove a species new to Great Britain. Mr. Hawkes also showed the paraphyses of this fungus under the microscope. Mr. Rodgers then read a paper on "Other Worlds than this," in which he described the sun and its analysis by the spectrum, the solar system, three stages in the life of a world—youth, maturity, and old age, and the arrangement of the planets in their stages of development judged by telescopic appearances. The paper also described stellar worlds, and their great distance adding to the difficulty of observation, the motion of the solar system in space, its direction, &c. The paper was illustrated by diagrams. December 8th.—Mr. Moore exhibited a large specimen of *Unio pictorum* from Ossington Lake; Mr. Rodgers, a collection of shells from Lamlash Bay. Under the microscope, Mr. Dunn showed a specimen of *Hydra vulgaris* with a branched tentacle (probably the result of an injury); Mr. Tylar, marine organisms, larval stage of starfish, echini, etc.; Mr. Sanderson, *Riccia fluitans*. December 15th.—Special: Geology. Mr. Insley showed fossils from Wenlock limestone, including *Calymene Blumenbachii*, and quartz crystals from various localities; Mr. Hawkes, specimens of asbestos and some of its manufactured products; Mr. J. W. Neville, fossil calamites, and a transverse section of the same under the microscope; Mr. Moore, section of fossil coral, *Cyathophyllum articulatum*. Among other exhibits Mr. Madison showed a singular shell of *Helix aspersa*, having two complete lips; Mr. Hawkes, pods of cotton plant, and ornamental articles from India made of native seeds; Mr. Deakin, jaw of porpoise, *Phocæna communis*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D, Zoology and Botany.—Chairman, F. T. Mott, F.R.G.S.—Monthly Meeting, December 17th. Attendance 10 (3 ladies). Exhibits: The rather uncommon lichen *Collema pulposum* (?) by Mr.

F. Bates, who had prepared a microscopic slide showing the moniliform character of the gonidial layer. These moniliform curved filaments were, he considered, quite undistinguishable from *Nostoc*, a fact which favoured the theory of Schwendeer that lichens consist of a fungus parasitical on an alga; a collection of dried leaves of various species of American oaks, by Mr. Vice; oak spangle-galls, and the fungus *Agaricus confluens*, by Mr. Grundy; large haws borne by the scarlet-fruited thorn, and a camera drawing of the large mole flea × 40, by Mr. Mott. Paper, "On the life-history of *Puccinia graminis*, the Wheat-Rust fungus," by Mr. G. Ward, describing its three stages, viz.:—the Æcidium stage on the leaves of the Barberry, formerly ranked as a distinct species under the name of *Æcidium berberidis*; the Uredo stage on wheat and other grasses in the summer, producing globular spores; and the Puccinia stage on the same plants in the autumn, producing the final, resting, or teleuto-spores, which are clavate and uniseptate. Mr. Ward had prepared several interesting slides, which were exhibited under the Society's fine binocular microscope, illustrating the stages of this remarkable fungus. The Chairman asked how it happened that while Rust was everywhere abundant, the wild Barberry was quite a rare plant in Leicestershire hedges. He thought there must be some other plant on which the Rust could pass through its first stage. The Chairman presented a list of 15 birds which frequented his garden, arranged in the order of their abundance, viz.:—1, House Sparrow; 2, Starling; 3, Missel Thrush, Song Thrush, Blackbird; 4, Robin; 5, Hedge Sparrow, Chaffinch, Blue-tit, Wren; 6, Great-tit, Pied Wagtail; 7, Yellowhammer, Spotted Flycatcher, Greenfinch. He remarked upon the scarcity of the Yellowhammer in his neighbourhood, and suggested that it might lead to interesting comparisons, if other members living in the different suburbs would prepare lists of birds arranged on the same principle.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC AND ARCHÆOLOGICAL SOCIETY.—At a well-attended meeting of the members of this Society, held on November 28th, Mr. James T. Irvine, clerk of the Restoration Works at the Cathedral, gave a very interesting address on "Saxon Architecture," illustrated by numerous drawings collected or made by himself. After pointing out the imitation of wooden construction this style presented in buildings actually of stone, the lecturer dealt with its other chief characteristics—the great internal height of the buildings when considered in regard to their length and breadth, the extreme thinness of the walls, the great height and narrowness of the openings, such openings in the earlier examples being wider at the base than at the top, whilst in the later ones the sides were parallel—the wedge-shaped quoin stones—the rude imitation of Roman mouldings—the gradual adoption toward the close of the Saxon period of features closely approaching Norman work. Mr. Irvine also called attention to the position of the window sashes, the earlier ones being fixed in the mid-wall, and later ones near the outside and provided with shutters; the ornamental character of the window jambs as at Boarhunt near Portsmouth, and in some remains found at Peterborough Cathedral; the use of coloured stone decoration as at Stone-juxta-Faversham; the singularly fine carvings found at Bradford in Wilts, date probably about A.D. 975, and at Barnack Church, near Stamford, the date of which the lecturer considered to be about A.D. 1060. Mr. Irvine also referred to the singular fancy for sundials, of which a beautifully carved specimen exists at Barnack.

Plate 1.

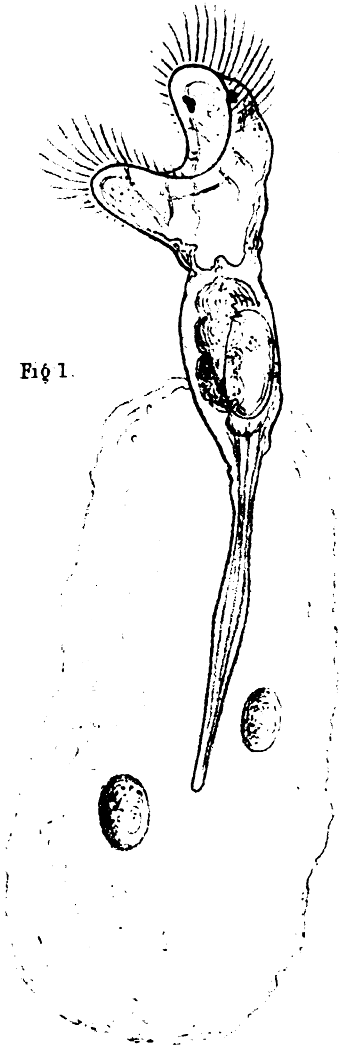


Fig 1.

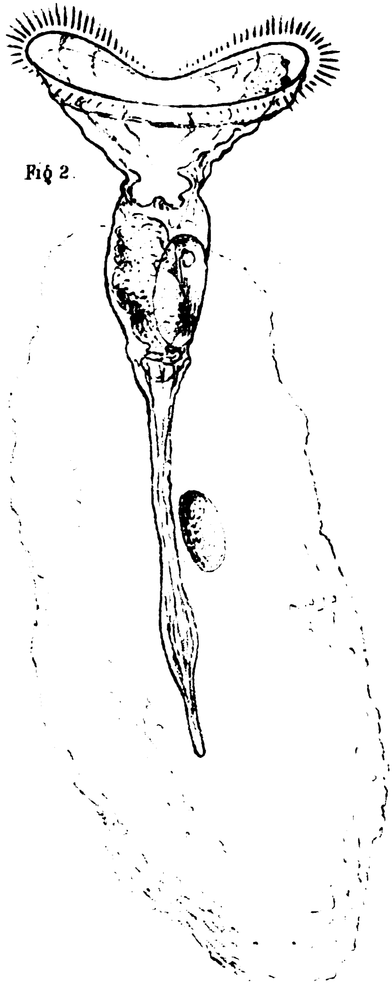


Fig 2.

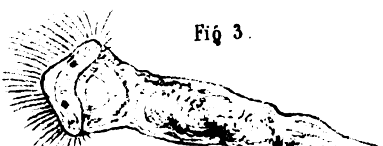


Fig 3.

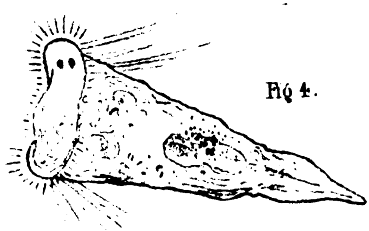


Fig 4.

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T.C.H. Del

W.B.G.

FLOSCULARIA MUTABILIS.

FLOSCULARIA MUTABILIS.

This very curious Floscule was discovered by Mr. Bolton in Olton Reservoir, near Birmingham, on August 7th, 1884, and he has since found it in several other pools in the neighbourhood. It is remarkable for having a disc with only two lobes; for possessing what appear to be two eyes on the dorsal lobe, near its summit; and for its habit of altering the shape of its disc till it somewhat resembles that of an Œcistes or Limnias, and then of swimming by vibrating the short setæ that surround the edge of the disc. There is another two-lobed Floscule, discovered by Mr. Hood, of Dundee, an account of which I shall shortly publish. I have named it *F. calva* from its remarkably short setæ. It does not, however, swim like *F. mutabilis*, nor does it possess red eyes. Oddly enough, however, it also is attached to its tube, and not to the stem of the alga on which the tube rests, so that it almost always tumbles off its perch when sent by post.

F. mutabilis generally swims backwards, circling very slowly, and sure to be soon pulled up by some obstacle. Now and then it has a fit of energetic straight swimming, but even then it is usually stem foremost. It frequently shuts up its lobes like a puckered bag; and I have seen it often protrude the real mouth (which, as in all Floscules, lies deep down at the bottom of the "vestibule") right beyond the outer edge of the lobes.

The young female (Fig. 3) is somewhat similar in shape to the adult, but has the swelling of the foot more marked.

I have seen three specimens of what I believe to be the male (Fig. 4), but from my not having seen it hatched I cannot be certain. The figure shows its external shape—it was on each occasion too lately hatched to detect the sperm bag and penis: it had no teeth or alimentary tract.

I may add that Mr. W. Dingwall, of Dundee, has sent me two or three specimens of a one-lobed (or rather lobeless) Floscule, an account of which will soon appear. There is now a regular series of Floscules with 7, 5, 3, 2, and 0 lobes.

C. T. Hudson, LL.D., F.R.M.S.

15th September, 1884.

PLATE I.

Description of the Figures.

Fig. 1.	Floscularia mutabilis (side view) at rest	$\frac{1}{80}$	inch.
,, 2.	,, ,, ,, swimming	$\frac{1}{80}$	,,
,, 3.	,, ,, young female	$\frac{1}{180}$	,,
,, 4.	,, ,, supposed male	$\frac{1}{180}$	,,

ON "THE BEST METHODS OF STUDYING BOTANY FOR BEGINNERS." *

BY F. T. MOTT, F.R.G.S.

Persons who begin to "study Botany" do not generally realise the vastness of the subject. Botany is the history of the whole Vegetable Kingdom, and the Vegetable Kingdom occupies much more space on the surface of this globe than the Animal Kingdom does, and has probably a much larger number both of individuals and species.

Such a subject can only be attacked piecemeal. We must divide it into Sections and study each Section separately, not, however, losing sight of their relations to each other and to the whole.

The history of Vegetables may be conveniently divided into six great Sections, viz.:—

1. The visible structure of a Plant; its parts or organs, as stem, leaf, flower, &c., the various forms of these, and the tissues of which they are built up. This is called Structural Botany.
2. The chemical constituents of these tissues, the chemical processes which go on within them, and the vital functions carried on by the different organs. This is called Physiological Botany.
3. The grouping together of plants of similar form, and the tracing of the blood relationship among these groups. This is Classification or Systematic Botany.
4. The distribution of these groups on the various parts of the earth's surface, on the land, and in the water. This is Geographical Botany.
5. The plants of previous geological periods which are now found fossilized in the rocks, and the correlation of these with existing species. This is Palæontological Botany.
6. The uses of plants to man and animals as food or medicine, or as materials for clothing, building, and various other arts. This is Economic Botany.

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* Transactions of Section D of the Leicester Literary and Philosophical Society. Read March 19th, 1884.

I have arranged these Divisions in a natural sequence, answering the questions—

What is a Plant?

How do Plants differ from one other, and how are they related to each other?

How are they distributed in space and in time? And

What is their value to animals?

But for the purpose of amateur study I should arrange them differently. What beginners find most interesting is the knowledge of plants by sight and by name, and some knowledge also of their economic uses.

We may arrange the sections, therefore, into an Elementary Department and an Advanced Department. The Elementary Department will include Nos. 1, 3, and 6—Structure, Classification, and Economic Use; and the Advanced Department will include Nos. 2, 4, and 5—Physiology, Geography, and Palæontology. As we are concerned at present with beginners only, we may dismiss the Advanced and confine our attention to the Elementary Department. How may an Amateur best set about to obtain some personal acquaintance with plants and their uses?

The plants which come under our notice in this country are in two groups—the wild and the cultivated. Some of our cultivated plants are also found wild, but the majority are importations from other countries and are only to be seen in gardens and hothouses. This does not make them any the less interesting to the Botanist, but for a beginner there is considerable advantage in restricting his early studies to our native wild plants, because these form a comparatively small and yet a fairly representative group, and an acquaintance with these will give him a general view of plant forms and plant life which may be afterwards extended in all directions. Moreover, wild plants of all the principal forms are readily accessible to everyone, while an average garden will only contain a small selection of the more showy forms.

Let a beginner, therefore, begin with the study of the British wild plants.

The first step is to get some knowledge of the structure of plants. In most towns there are, during the winter, courses of lectures by certificated Science teachers, and if Botany is one of the subjects no better introduction can be had than passing through such a course. The course usually consists of from twenty to thirty lectures of an hour each, and the usual fee is 2s. 6d. for artisans who can earn the Government grant for the teacher, and from 10s. to 20s. for all other persons for whose teaching the Government will pay nothing.

The course begins in the autumn and finishes in the spring, and the student who goes through it conscientiously will gain a fair knowledge of the principles of Elementary Botany.

If no such course is available, there are plenty of good books from which he may get similar information, but it is rather drier and harder work to read for yourself than to follow a teacher. Among the many books on Elementary Botany, of which I have no less than sixteen in my own library, the following three may be particularly recommended, viz.:—

Dr. Hooker's "Primer of Botany," price 1s.

Prof. Oliver's "Lessons in Elementary Botany," price 4s. 6d.

Mrs. Kitchener's "A Year's Botany," price about 6s.

If the student happens to possess any other recent work of the kind it will do nearly as well. If not, let him buy one or all of these and read them through, carefully following their instructions. Nearly every book will contain something not found in the others.

The next step will be to get a personal acquaintance with the wild plants, to learn to know them by sight and by name, to be able to classify them, and to ascertain their uses. Something of all this will have been gathered in going through the books already mentioned, but a good deal more is required. In order to impress upon the memory the appearance and the names of plants they require to be brought *frequently* under notice—once or twice is not sufficient.

For this purpose there is no better method than the forming of an Herbarium or a Botanical Garden, or both. The plants must be collected, the names and classification worked out from books, the specimens frequently handled, and then preserved either dried in an Herbarium or living in a classified garden—the latter is the less common but perhaps the more interesting method; but it is also much more difficult, because some plants are too large and others too small to be easily manageable, while some want water, others rock, or peat, or sea sand, and will not flourish in common garden soil. The dried garden, *hortus siccus*, or Herbarium, is therefore the usual method of preserving the specimens, and it is easy, cheap, and fairly satisfactory. Many of the books give full instructions for drying and mounting the plants, but I may say here that perhaps the best paper for drying is that supplied by West, Newman, and Co., 54, Hatton Garden, London; that a beginner should have at least three quires of this paper, and that the plants must be changed into dry papers at least three times—first after twenty-four hours' pressure, then after two or three days more, and again after a week. Or they may be laid in the drying papers in a tin dish just large enough to hold them, dry sand spread on the top an inch thick, and placed on a warm stove or in an oven of moderate heat. They will want careful watching so as not to bake too rapidly, but with proper attention they may be got perfectly dry in one or two days, or even in a few hours, by this method, and will keep their colour better than if dried more slowly. The mounting paper should be about 16½ins. by 10½ins., and the specimens fastened on by strips of gummed paper, using only just as many as will hold all parts firmly to the paper, and cutting them broad enough to give a firm adhesion. They are often used too narrow. Some persons glue the whole specimen to the paper, and in Herbariums subject to continual turning over, as in public museums, this is the safest; but in private collections it is, I think, unnecessary and undesirable, as it takes more time, gives a more unnatural appearance, and prevents the specimen from being changed or in any way moved for examination. The species of each genus should be put together in a sheet of coloured paper, labelled outside, and the packets properly arranged in a cabinet, or in a set of boxes made to stand up like large books on a shelf.

For determining the names and characters of British plants there are several good works. The most costly of these is Sowerby's "English Botany," of which the third edition consists of eleven volumes, with a twelfth now in preparation, price about £20, giving a coloured plate of every species. This is excellent as a help and for additional information, but it is not good to work by, having no synopsis or key of any kind. I should recommend for beginners Bentham's "Illustrated Handbook of the British Flora," in two volumes, with admirable woodcuts of each species. When they have acquired some knowledge of common plants Hooker's "Student's Flora," price 9s., will be better, as although without plates or woodcuts it is very compact, very full and clear, and contains most of the modern seggregates, or distinct varieties of certain species, which are omitted by Bentham for the sake of simplicity. Babington's "Manual" is nearly as good as Hooker and about the same price. Anne Pratt's large work with coloured plates is useful for reference and for popular information about the history and qualities of plants, but is not precise enough in its descriptions nor accurate enough in its plates for the real student. Leo Grindon's

"British and Garden Botany" contains an immense amount of interesting information, but is not a good working book. When a fair acquaintance with British plants has been obtained, if the student wishes to go further and examine the plants of gardens or of the world, the number of species is so large that no one book has yet attempted to describe them all. Loudon's "Encyclopædia of Plants" gives descriptions of nearly 20,000 species, and woodcuts of 10,000, and is an invaluable work; while Le Maout and Decaisne's "Descriptive and Analytical Botany," edited by Dr. Hooker, gives an excellent account of the 300 orders of known plants arranged according to the most modern system of classification. The price of the first is about two guineas and of the second 30s. If to these the student adds Sachs's "Text-book of Botany," price about 30s., he will have, in addition to the works previously recommended, a Botanical Library sufficient for most amateurs.

ON THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

The researches of British geologists, continued without intermission since the beginning of the present century, have at last rendered possible the study of the physiography of the Midlands during the geological ages which are past.

The completion of the one-inch geological map of England by the Government Survey during the year 1883 marks an epoch in the history of geology; but, in the case of amateur geologists, it is certain that the publication of these maps, furnishing—as they are supposed to do—a "royal road" to the study of the rocks of any district, has led them to take too many things for granted, and to suppose that finality in things geological has been attained.

In this paper I propose to consider what is known of the Pre-Carboniferous strata—the Archæan, Cambrian, Silurian, and Devonian Formations—of the Midlands; to detail some startling discoveries which have been made within the last two or three years with regard to them, and to point out their bearing upon palæo-physiography and upon certain geological problems of high interest.

Methods of Investigation.—Fortunately for local geologists the rocks of the British Isles have, perhaps, been more crumpled up, broken, eroded, and disturbed than any other area of equal dimensions upon the surface of the globe. The axis of greatest elevation now lies to the west, running through the Lake District and Wales. From this it results that the strata have a general dip or slant to the south-east, the oldest rocks forming the actual surface of the ground in these western tracts, but being covered over and concealed by newer rocks as we proceed eastward. If all the beds of rock lay in regular undisturbed sheets, as they must have originally been deposited on the sea bottom, we, in the Midlands, could never hope to discover any Pre-Carboniferous strata at the surface, for they would be below thousands of feet of later-deposited rocks. But, during the upheavals and depressions which the British Isles have experienced —and they have undergone many changes of level, amounting to thousands of feet—the rocks have cracked, and the beds along one side of the crack or "fault" have been elevated or depressed as the case may be. Then lateral pressure, whose effects have but lately been recognised on a grand scale in the Highlands of Scotland, has thrown the rocks into great folds, having crests and hollows. Following these earth movements, the agents of denudation have swept away the material from the "upthrow" sides of the faults, and from the crests of the earth-folds, and thus the wonderful variety of rocks which characterises our country has been produced, and we are able to find strata of the same age and of similar lithological characters to those of Wales and the Lake District within a short distance of Birmingham and Leicester.

But to discover and identify every exposed area of these old rocks in the Midlands our search must be both keen and careful, and we must have a competent knowledge of what to look for, gained by the study of typical sections and specimens. Although the geological surveyors are instructed to walk along the four sides of every field and to examine every patch of rock—and I can bear testimony to their hard and generally excellent method of work—yet they missed the true interpretation of many important exposures, and it is clear that in the present position of British geology more good will result from the close study of a limited area than from occasional scamperings over a wide region. I remember well, many years ago, how I walked over all Leicestershire to find an outcrop of the Rhaetic beds, which I discovered at last in a brick pit close to my own back door!

We will consider, in the first place, those Midland areas in which the old Pre-Carboniferous strata actually rise to the surface; secondly, the places where they have been reached by mines or deep bore holes; and lastly, the probable manner in which they extend underground between the points where their presence has been actually determined. Only those points will be considered in detail which have not been already published.

Surface Exposures of Pre-Carboniferous Rocks.—The ancient rocks which we have to describe crop out as "islands" or "bosses," along a line from south-west to north-east, extending from the Malvern Hills, by the Wrekin, the Lickey Hills, and the Hartshill Range to Charnwood Forest in Leicestershire.

1.—*The Archæan Rocks of Charnwood.**—Charnwood Forest is a hilly rocky tract of about thirty square miles, lying between the towns of Leicester, Loughborough, and Burton. The rocks consist of coarse slates, grits, and agglomerates, about ten thousand feet in thickness, and of volcanic origin. They strike from north-west to south-east, and are broken through by syenitic and granitic masses, with the result that at one point (Brazil Wood) the slate has been converted into a micaceous schist. The Charnwood axis is continued to the south-east, beneath the Triassic strata of South Leicestershire, being overlaid in that direction by Cambrian rocks presently to be described. The ashy slates of Charnwood are believed to be of Archæan or Pre-Cambrian age, for the following reasons:—(*a*) they agree well, both when studied in the field and when examined microscopically, with the *Pebidian Formation* of Dr. Hicks; (*b*) they have yielded no fossils of any kind; (*c*) they are certainly overlaid by Cambrian strata, although the junction is concealed from view by newer beds.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER VII.—GENESIS.

BY W. B. GROVE, B.A.

Genesis is the multiplication of individuals. In the cases most familiar to us this takes place in such a way that like produces like, the offspring closely resembles the parent. But modern science shows us that this is not the most

* See "Geology of Leicestershire," by W. J. Harrison; and Hill and Bonney, Quart. Jour. Geol. Soc.

common form of genesis; in the great majority of plants and in numerous animals like produces unlike, the offspring does not resemble the parent. This is the exact reverse of the opinion which the ancients held and the unscientific of the present day would express, but it is nevertheless the correct one, and the scope of its application every year grows wider. These two modes of multiplication are designated respectively by the apt names of *homogenesis* when the successive generations are alike, and *heterogenesis* when they are diverse.

But we may look at the matter from another point of view—the production of a new individual may result from the fusion of the whole or a portion of each of *two* more or less distinct previously existing individuals, *i.e.*, from a sexual act; or it may originate merely by the separation of a part of *one* individual in such a form as to be capable of independent growth. These two modes are called by the delightfully expressive names of *gamogenesis* and *agamogenesis* respectively.

Herbert Spencer then lays down the following laws:—(1) Homogenesis is always gamogenesis; (2) Heterogenesis is agamogenesis interrupted more or less frequently by gamogenesis. These statements we will now examine.

The kind of homogenesis with which we are most familiar is that met with in the larger animals, where each generation consists of males and females; it occurs under three forms, as viviparous, oviparous, and the intermediate ovoviviparous genesis. As we descend in the animal kingdom we find homogenesis become rarer and rarer, and at last entirely replaced by the other mode. Amongst plants, as will be seen hereafter, homogenesis, strictly speaking, never occurs.

When heterogenesis prevails we shall find that after a generation of perfect males and females there will be a generation of asexual individuals, which produce the next generation by a process of budding. This next generation may consist of males and females like those with which we started, or may be itself also asexual, and produce another generation by budding; but sooner or later the sexual generation will again occur and complete the cycle. Illustrations of both these modes are most readily seen in plants. Take a simple uniaxial plant, originating from a seed, and having a terminal flower. The stem and leaf appendages of this constitute a single individual, which is itself sexless, and produces buds, each bud being a new individual. From certain of these buds, which are male, pollen-grains are formed; from certain others, which are female, ovules (or rather embryo-sacs) are produced. In certain of the heterosporous higher cryptogams the homologous parts are called microspores and macrospores respectively. Each of these sexual individuals undergoes further growth (reduced to a very small amount in the Phanerogams), and then, by the union of their products, *i.e.*, the sexual organs, a seed is produced. The cycle, if I understand it rightly, is thus represented by A, B; A, B; etc. In multiaxial plants the only difference is that fresh individuals may be produced by budding for many generations before the sexual generation recurs. In Ferns and Mosses the same arrangement is seen except that a spore in these cases is usually capable of giving rise to both male and female organs, though even here we meet with a decided tendency to unisexuality. Analogous cases to all these are met with in the lower groups of the animal kingdom. The agamogenesis, *i.e.*, the production of buds, may take place in different way which are called metagenesis (both external and internal), parthenogenesis, and pseudo-parthenogenesis, but space forbids me to enter into these.

It is obvious that the classification given by Herbert Spencer does not exhaust the possible modes of occurrence of homo- and hetero-genesis. It is conceivable (1) that an organism should multiply by continued agamogenesis, which might be either continual homogenesis or that combined with heterogenesis; and (2), that when gamogenesis recurs it might recur at more than one point in the cycle and under more than one form. I am not aware that any instance is known of the latter mode, but it is at least possible. There are, however, numerous instances which seem to fall under the first head, and in which proof of the recurrence of gamogenesis is wanting, although in many cases it is probable. In the realm of Fungi, *e.g.*, the whole series of the Bacteria and Yeast-fungi, the greater part of the so-called "Fungi Imperfecti"—the Hyphomycetes and Coniomycetes—the Basidiomycetes to which the larger Fungi, the mushroom, &c., belong, and scattered examples in other groups, would fall, so far as is at present known, under this head. In most of these cases we can only account for the seeming absence of gamogenesis by supposing either that it occurs in some form which has hitherto eluded research, or that these are merely parts of the life cycle of some other organisms with which their connection is as yet unsuspected or unproved, and in which the gamogenesis will be found. The subject will be better discussed in connection with a future chapter.

The essential act of gamogenesis is the "union of two centres or cells produced by different parent organisms." We find all possible stages of this union, from the fusion of two entire individuals, as in the Monads, and the fusion of their contents as in the Diatoms and Desmids, and in the Conjugate Algæ (for there each cell is practically a distinct individual) upwards to the higher animals and plants, in which the portion separated for the reproductive process is but an extremely small part of the parent organism.

The mysterious result of this union suggests that the cells which take part in it are specialised in some peculiar way, but the evidence goes to prove that they are rather *unspecialised*; that, in fact, in proportion as cells are specialised they are unfitted for reproductive purposes. Accepting Herbert Spencer's hypothesis of physiological units, we may say that a cell which is fitted to reproduce the species must contain all the physiological units essential for that species, and that specialisation consists in the removal of certain of these units, so that some kinds of them either entirely disappear or are reduced below the necessary standard.

The fact that the reproductive cells, in most cases, are capable of only a very slight further growth, if they remain un-united with each other, is a proof that the units of which they are composed are very nearly in a state of stable equilibrium among themselves; by their mixture, the equilibrium is destroyed and a new series of structural changes is instituted.

Why does this mixture occur, and when? Here we consider only the latter question, reserving the attempt to supply an answer to the former for a future chapter. It is found that in most cases in the higher plants agamogenesis prevails when nutrition is abundant, and that when from any cause nutrition becomes reduced nearly to the level of expenditure, that is, when active growth is beginning to cease, then gamogenesis intervenes. The same connection is observable in many animals. I need not recount these well-known instances, but it is interesting to notice that illustrations of the same law are more and more being observed among the lower plants. It has long been known that to obtain the zygospores of Mucor it is necessary to starve the plant, to grow it without access of air; and Brefeld's more recent discoveries prove that the same method is required to obtain the sexual (sclerotoid) condition of Penicillium, which in the natural state is probably very rare. In fact, the instances of the law thus connecting innutrition and reproduction are so numerous, and the exceptions comparatively so few, though well marked, that it cannot but be true as a general rule, though probably complicated with some other law (unknown) which in certain cases interferes with its action.

ON "THE DEVELOPMENT OF A FERN FROM ITS SPORE."*

BY G. C. TURNER.

Two hundred and fifty years ago it would have been a dangerous thing to have discussed a subject so intimately connected with the powers of darkness as "fern seed." The researches of latter days have, however, cleared away from the character of ferns the "uncanny" imputations of former ages. We know now that "fern seed," though collected on St. John's Eve, will not assist even an insolvent debtor to become invisible; we know that moonwort, though gathered by the light of a hundred full moons, has not the least effect in loosening locks, bars, or fetters, nor will it with a touch

"Unshoe the new-shod steed."

We know so much, but most of us do not yet understand the curious little drama which is being acted humbly and quietly upon those minute "marchantia-like" green specks which are strewn over our ferneries and wayside banks and woods.

The development of the fern from the spore had been a mystery through all time up to the middle of the present century. The honour of the discovery of the true mode of reproduction in ferns is due to Nägeli of Zurich, who, in 1844, published a memoir entitled "Moving Spiral Filaments in Ferns," wherein he announced the existence of the bodies now called antheridia. But he did not ascertain the whole truth, for he described the archegonia as modified forms of the antheridia. In fact, he seems to have been so taken up with his "moving filaments" (movement in the vegetable world being considered as a novelty in those days) that he regarded other phenomena as of secondary interest, and evidently watched them less carefully, for he describes an archegonium filled with sperm cells which emerged from it as from the antheridia. However, in the following year Count Suminski, of Berlin, cast clearer light upon the subject, and Hofmeister and others following confirmed previous observations and added new ones.

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read October 17, 1883.

The development of the fern from the spore may be watched thus:—

Choose a frond with ripe spores, place it between drying paper for a day or two, and then shake it over prepared soil. Shaking is preferable to scraping unless you are trying to porduce new varieties; in that case the spores should be sown as thickly as possible. By "prepared soil" is meant soil that has been either roasted or scalded in order to destroy all vegetable or animal germs that may be in it. Shallow pans should be used half filled with bits of broken pot to ensure good drainage, and the surface of the soil should be made smooth by gentle pressure.

The spores should not at first be watered directly, but the pots should either stand in water (distilled or boiled), or be plunged in water once a day for a few seconds.

For more convenient observation the spores may be sown on glass or on a bit of pot; the former is rather a tedious process.

The spore, like all true spores, will germinate from any point of its surface indifferently.

All spores do not germinate equally soon, spores from Osmunda germinating much sooner than others.

Usually the spore gives rise first to a long slender filament the terminal cell of which divides and sub-divides into a flat leaf-like and usually kidney-shaped expansion termed the prothallium, but in the case of Osmunda the prothallium is formed at once, and there is no long filament.

Scattered round the margin of the prothallium and on the under side are the antheridia, which are minute cellular sacs usually stalked—(I have even seen them on the stem of the young fern)—whilst on the under surface just behind the indented portion are the archegonia, which are bottle-shaped organs, buried in the substance of the "cushion," as this part is called, because here the prothallium consists of several layers of cells, instead of a single layer, as it does nearer the margin.

The prothallium shows a decided diœcious tendency. Sometimes from a whole sporangium all the prothallia developed will bear antheridia only; in others the archegonia appear later, to be fertilised by antheridia from younger prothallia.

Under certain conditions a prothallium will produce prothallia by gemmæ, and will sometimes, though rarely, produce the new fern by a process of budding.

The antheridia which contain the sperm or antherozoid cells are protected by a wall of thin cells.

When these sperm cells are ripe the parietal cells absorb water violently and swell up, until finally the antheridium is ruptured at the apex and the antherozoid cells escape, and out of each cell is set free an antherozoid, coiled spirally round three or four times. The finer anterior end of each antherozoid is furnished with cilia, while the other or posterior end often drags with it a vesicle containing colourless granules; this subsequently falls off and remains at rest, while the filament continues its motion alone.

Imbedded at the base of the archegonium is the central cell, and leading up from it is the central canal. The central cell divides and rounds itself off, forming a smaller cell, the oosphere. When this oosphere is ready to be fertilised the canal swells up and becomes mucilaginous, and finally watery mucilage, and the protoplasm from the canal cells is forced out of the opened neck.

The antherozoids are retained in numbers by this mucilage, several of them obtain an entrance into the canal, stopping it up—a few reach the oosphere, force themselves into it, and disappear. After thus being fertilised the oosphere swells up, develops root, and frond, absorbing in the process the protoplasm contained in the prothallium, and begins life on its own account as a seedling fern.

NOTE.—*The above account is partly condensed from Sachs's Text Book.*

KOCH'S COMMA BACILLUS.

BY W. B. GROVE, B.A.

At the Conversazione of the Midland Institute in January I exhibited a slide of this now famous microbe, which was especially interesting from its history. It was prepared by Professor Strauss, of the French Egyptian Cholera Mission (so I am informed), from bacilli grown by himself in gelatine. He prefers for the present to call it, not the Cholera Bacillus, but by the name given above. I obtained it from Dr. R. Suzor, of Paris. An examination under a sufficiently high power (a one-tenth is the lowest that is satisfactory) reveals a number of minute rod-like organisms, some single, others connected in chains of two or more, mingled with occasional threads in which no division into rods could be detected. Their most striking feature was that which gives them their common name; most of the rods were more or less bent, some so as to form about the sixth of a circle; others were quite straight, and every intermediate stage could be found, One of our chief biologists has attempted to parody the famous joke about the crab, by saying that Koch's Comma Bacillus is so-called (1) because it is *not* comma-shaped; (2), because it is *not* a Bacillus. But an inspection of these authentic specimens shows that he is wrong in both particulars; they *are* curved exactly like a written comma, but of course without the distinct head which we see in a printed comma. Moreover, they *do* belong to the genus Bacillus—in the Vibrio form it is true, but without the spiral which distinguishes the genus Spirillum. It is now well known that the members of the old genus Vibrio were of two kinds, some merely undulated (Bacillus), some truly spiral (Spirillum). For this reason, the word Vibrio is now dropped as a generic term.

Other observers than Koch have met with Bacilli curved in a similar comma fashion; among these one is stated to be very common in the mouth of many healthy persons, and another has just been discovered by Dr. Deneke, of Göttingen, in mouldy cheese. These all present great similarity in their form, although differing slightly in their mode of growth in nutrient media. But it is obvious that this similarity is no proof of identity. There are already numerous instances known of Bacilli which, while morphologically almost identical, are physiologically widely different, *e.g.*, the hay-bacillus and that of splenic fever, the bacillus of glanders and that of tubercle.

Through the kindness of Mr. Sampson Gamgee, of this town, my attention has been called to a book just published in Italy by Dr. A. Bianchi* containing the observations made by the famous Italian physician, Prof. F. Pacini, during the cholera epidemic in Florence in 1855. Copies are given of drawings of the micro-organisms which Pacini found in the bodies of those who died of cholera, made by him at the time, thirty years ago, but not published during his lifetime. Among these, one which he calls a Vibrio so closely resembles Koch's Comma Bacillus that it can scarcely be doubted that Pacini met with the same organism which Koch afterwards rediscovered. In one striking point this similarity is most convincing; in Koch's Bacillus it frequently happens that when two curved cells are in contact, end to end, the concavities are turned in opposite directions, thus forming a distinct S, and this feature is well represented by Pacini.

* Nuove Osservazioni Microscopiche sul Colèra (Milan, 1885), p. 4, fig. 2.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 23, Vol. VIII.)

CYPERACEÆ *(continued)*.

CAREX *(continued)*.

C. Pseudo-cyperus, *Linn.* *Cyperus-like Sedge.*

Native: Moist, shady places, damp banks, and near pools. Local, but widely spread. June.

I. Sutton Park, nearly extinct; Bentley Park; Maxtoke; Marston Green; bank near Olton Railway Station; copse near Henfield, Knowle; pool by Barber's Coppice, Hampton-in-Arden. Earl's Wood Reservoir, with female flowers in the top of male catkin; small pool, near Three Maypoles, Shirley Heath.

II. On the edge of a pool at Kinwarton, *Rufford, Purt.*, ii, 418. Kenilworth, *Y. and B.* Side of pools and waters near Arbury Hall; Pinley, near Stoke Heath, *Kirk. Phyt.*, ii, 971. Pond near Cawston House; pond outside Frankton Wood, *R. S. R.*, 1877. Honington, *Newb.* Twelve o'clock riding, Combe Woods, 1875; abundant in a wood at Tile Hill; pond near Tile Hill Wood; Bearley Bushes; Snitterfield Bushes; Shortwood Coppice, near Tardebigg.

C. paludosa, *Good,* *Lesser Pond Sedge.*

Native: Near canals, ditches, marshy ground, and damp woods. Locally common. April to June.

I. Sutton Park; Middleton; in several places on the Warwick Canal from Olton to Knowle; Bradnock's Marsh; Barston Marsh; Blythe Bridge, &c.

II. Near Wroxall Abbey; Hill Wootton; near Kenilworth, *H.B.* Radford, *Y. and B.* Side of river by Little Lawford Mill, *R. S. R.*, 1877. Canal near Newbold-on-Avon; canal near Rowington; canal near Yarningale Common; Binton Bridges; pool, Combe Abbey Grounds.

Var. *b. Kochiana.* More local.

I. Pool Hollies Wood, Sutton Park; Water Works Ground, Witton Lane; Bradnock's Marsh; Blythe Bridge; canal near Hockley; Henfield; Knowle.

II. Tredington, *Newb.;* canals near Rugby, *L. Cumming;* Old Canal near Newbold-on-Avon; Binton Bridges.

This variety occurs frequently with the type, but it requires minute examination to separate them, so that it may be found in many of the districts assigned to var *a*.

C. riparia, *Curtis.* *Greater Pond Sedge.*

Native: Near rivers, pools, canals, and in damp woods. Locally common. April to June.

I. In most of the canals in the Tame basin; Sutton Park, very rare; Middleton; Kingsbury; Anstrey, near Tamworth; Bradnock's Marsh; Righton End; boggy coppice near Stonebridge; Meriden Marsh; Blythe Bridge, near Solihull; Henfield and Temple Balsall.

II. Honiley, *Y. and B.;* Honington, *Newb.;* in all the canals in the Avon basin more or less abundant; Alveston Pastures Wood; Binton Bridges; wood near Spernal; Seas Pool, Arbury; pool in Combe Abbey Grounds.

A peculiar form occurs in a boggy coppice near Stonebridge in which there are female flowers and perfect fruit at both top and bottom of male spike.

C. ampullacea, *Good.* *Bottle Sedge.*

Native: Near pools and ponds. Very local. May, June.

I. In several pools about Middleton, *Ray, Cat.*, ed. 1, p. 145; Packington, *Aylesford, B. G.*, 636; Edgbaston Pool, *With.*, ed. 4, 110; Sutton Park, very abundant; Coleshill Pool; Marston Green; near Solihull.

II. Pit at Wroxhall, *H. B.;* Hill Wootton, *H. B.;* Milverton, *Y. and B.*

C. vesicaria, *Linn.* *Bladder Sedge.*

Native: In marshes, near pools, and in damp woods and copses. Local, but widely spread. May, June.

I. Packington, *Aylesford, B. G.*, 636; Edgbaston Pool, *With.*, ed. 4, 110; Kingsbury Wood; damp pastures near Coleshill; Coleshill Pool; Bradnock's Marsh; Olton Pool; osier plantation near Solihull; copse near Henfield, Knowle; Earl's Wood in several localities.

II. At the edge of a large pit near to Great Alne Mill, *Purt.*, ii, 451; Harbury, *Rev. A. Blox.;* pond by Blue Boar Lane, *Blox.*, *R. S. R.*, 1874; pond at Frankton Wood, *R. S. R.*, 1877; Seas Pool, Arbury; Binley Common; footway from Eastern Green to Allesley; Shortwood Coppice, Tardebigg.

GRAMINA.

[*Digitaria sanguinalis*, Scop. *Mr. Bromwich* finds this as a casual weed near Kenilworth Station.]

SETARIA.

S. viridis, *Beauv.* *Green Bristle-Grass.*

Casual: In gardens and cultivated land. Rare. August.

II. Kenilworth, *H. B.*, *Herb. Brit. Mus.*, Myton, on railway banks, H. B.! Leamington, *Y. and B.* Old gardens in the Southam Road, near Leamington.

[*S. glauca*, Beauv. This occurs as a weed of cultivation near Milverton, *H. B.*]

ANTHOXANTHUM.

A. odoratum, *Linn.* *Sweet-scented Vernal Grass.*

Native: In pastures, woods, on heath lands, roadsides, and banks. Common. April to June. Area general.

The var. *a. genuinum* is the more frequent plant on healthy pastures. Var. *b. villosum* occurs abundantly in several of the damp shady woods. I cannot think these are more than inconstant forms.

DIGRAPHIS.

D. arundinacea, *Trin.* *Ribbon Grass.*

Native: By rivers, streams, pools, and in drains, &c. Common, June, July.

I. Aston, in River Tame; Sutton Park; Middleton Heath; Polesworth; canal near Atherstone; Plant's Brook; Water Orton; Forge Mills; Marston Green; Bentley Heath; Temple Balsall; Earlswood.

II. Near Leamington, *Perry Fl.;* Rugby district; *R. S. R.*, 1874, Honington; Tredington; Alveston Heath; Stratford-on-Avon; Wixford; Oversley; Rowington; Sowe Waste and Ansty Canals; pool in Combe Abbey Grounds; Binley Common.

PHALARIS.

P. canariensis, *Linn.* *Canary Grass.*

Alien: On waste heaps; and in cultivated fields. Rare, July.

I. On waste heaps near Wylde Green; roadsides near Oscott College, Old Chester Road; railway banks, Sutton Park.

II. Coventry Park, *Kirk, Herb. Perry*, near Leamington; canal side near the Cape, Warwick, *H. B.;* corn fields near Bilton, Rugby

ALOPECURUS.

A. agrestis, *Linn.* *Slender Fox-tail Grass.*

Colonist: In cultivated land and on roadsides. Local and common. June, July.

I. Fields near Middleton; Coleshill; Marston Green; abundant near Sheldon Church; Hampton-in-Arden; Barston Marsh; Marston Green; Henfield, near Knowle.

II. Frequent in fields near Leamington and Warwick, *H.B.;* Honington; Tredington; Armscote; Ilmington, *Newb.;* Rugby district, *R.S.R.*, 1872; Wilmcote; Lapworth.

A. geniculatus, *Linn.* *Bent-stemmed Fox-tail Grass.*

Native: Near pools, marshes, waysides, ditches, and other wet places. Common. May to September. Area general.

A. fulvus, *Sm.* *Orange-anthered Fox-tail Grass.*

Native: Near pools and ponds. Rare. June to August.

I. Edgbaston Park, *With.*, ed. vii, 151; meadows by Powell's Pool, Sutton Park, 1872; abundant on the shores of Coleshill Pool, 1875-8; marsh near Hill Bickenhill; Earl's Wood Reservoir, abundant.

II. Pit in Rounsel Lane, Kenilworth, *H.B.*, *Herb. Brit. Mus.;* Shrewley Pool, *H.B.;* Kenilworth Old Park, *Y. and B.*

A. pratensis, *Linn.* *Meadow Fox-tail Grass.*

Native: In pastures, meadows, on roadsides and banks. Common. May to August. Area general.

b. pronus.

Occasionally with the type, a variety scarcely to be distinguished.

PHLEUM.

P. pratense, *Linn.* *Cats-tail Grass.* *Common Timothy Grass.*

Native: In pastures, meadows, and roadsides. Common. May to July. Area general.

b. nodosum, Linn. Local or rare.

I. Borders of a pasture footway from Righton End to Barston Marsh.

II. Near Tachbrook, *Y. and B.;* Alveston Heath! *Newb.;* Harbury Heath; sandy pasture near Rose Hall, Oversley; fields near Binton; sandy road sides near Little Lawford Mill; Combe Fields.

Var. *majus.* Very local.

II. Honington, *Newb.*; near Chesterton, *H.B.*; Harbury Heath, abundant on the borders of cornfields; in principal drive of Alveston Pastures Wood; on the borders of fields, Baddesley Clinton.

This is a tall form, often four feet high, with spikes six or more inches long, growing singly, and usually thinly scattered on the borders of cornfields.

GASTRIDIUM.

G. lendigerum, *Gaud.* *Awned Nitgrass.*

Colonist: On the borders of cultivated fields. Very rare, and of uncertain occurrence. July.

II. Cornfields near Alcester, *Blox. N.B.G.S.*; Hampton-on-the-Hill; Grove Park; Norton Lindsay; Wilmcote; King's Lane, Stratford-on-Avon, *Herb. Perry*; Tachbrook, *H.B.*!

POLYPOGON.

[**P. monspeliensis,** *Desv.* *Annual Beard Grass.*

Casual: In waste heathy places. Rare. July.

II. Kenilworth Heath, *Dr. St. Brody*!]

Probably brought with foreign skins.

AGROSTIS.

[**A. spica-venti,** *Linn.* *Spreading Silky Bent Grass.*

Casual: On the borders of corn fields. Very rare. July.

II. Saltisford, *J.G.P.*, *Herb. Perry*! Abundant in sandy corn fields, Milverton, *H.B.*]

A casual of uncertain occurrence.

A. canina, *Linn.* *Brown Bent Grass.*

Native: In damp woods and copses, and on damp roadsides. Local but widely spread. June, July.

I. Sutton Park; New Park, Middleton; Heathland, Atherstone Outwoods; Bentley Park; roadsides near and in Ironstone Wood, Oldbury; Bannersley Pool; marshy coppice near Packington; damp roadsides Brockhill Lane, near Balsall Street; Temple Balsall; Olton Pool.

II. Woodloes! Haywoods! *Y. and B.*; Haseley; Rounsel Lane, *H.B.*; marshy coppice near Kingswood; Old Park, Ragley.

A. alba, *Linn.* *White Squitch.* *Marsh Bent Grass.*

Native: In damp places by roadsides, pastures, and meadows. Common. June, July.

I. Sutton Park; Middleton; Temple Balsall; Arley, &c.

II. Chesterton Wood; Alveston Heath; Wilmcote; near Wootton Wawen; canal, Newbold-on-Avon, &c.

b. stolonifera. Rare.

II. On sandy banks, old railway cutting near Henley-in-Arden.

A. nigra, *With.* *Black Squitch; Black Bent Grass.*

Native: On the borders of cultivated fields, railway sidings, old brickyards and waysides. Local, but widely spread. July, August.

I. Sutton Park, on railway sidings abundant; in like places at Penns and Castle Bromwich; lane by The Grange, Erdington; borders of fields, near Bentley and Hartshill; Tamworth; Temple Balsall; brickyard near Berkswell Station; fields, Meriden, &c.

II. Borders of fields near Itchington; marly banks near Chesterton Wood; borders of fields, Alveston Heath; Wilmcote; fields and lanes, Ragley and Alcester; Tile Hill; Allesley; Kenilworth; Stoneleigh.

More robust, with rough leaf sheaths and more strongly-toothed spikelets rachis and pedicels, ligule more prominent, and flowering nearly a month later than *A. vulgaris*.

A. vulgaris, *With.* *Common Bent Grass.*

Native: In pastures, meadows, roadsides, and banks. Common. June, July. Area general.

b. pumila. Rare. Wet sandy places.

I. Above Blackroot Pool, Sutton Park; wet sandy roadsides near Stonebridge.

II. Lye Green! *Herb. Perry.* Honily, *H. B.!* Haseley Common; Sitch field, Chesterton; near Hatton, *H. B.*

CALAMAGROSTIS.

C. Epigejos, *Roth.* *Wood Small Reed.*

Native: In woods and shady damp places. Local. July.

I. Upper stew in Edgbaston Park, *With.*, ed. 7, 197; small wood near Tyburn, *F. Terry!* wood at Walmley, *J. B. Stone!* Coleshill Pool; Arley Wood.

II. Dunington; Salford; Wetherly, *Purt.* i., 178; woods at Alcester, *Blox.;* Allesley, *Bree, Mag. Nat. Hist.* iii., 163; Brandon Wood; near Arbury Hall, *T. Kirk, Phyt.* ii., 972; Stoneleigh, *T. K.*, *Herb. Brit. Mus.;* Moreton Morrell, *Y. and B.;* Tachbrook and Harbury; Lighthorn Roughs; Grove Park! *H. B.;* between Shipston and Darlingcote, *Newb.;* Alveston Pastures; Warwick Old Park; Chesterton Wood; Oversley Wood; Old Park Wood, Ragley; Bearley Bushes; Combe Woods; Prince Thorpe Wood; Ufton Wood; Wayland Coppice.

C. lanceolata, *Roth.* *Purple-flowered Small Reed.*

Native: In damp woods and near pools. Very rare. July.

I. Olton Pool, *J. Bagnall, Herb. Brit. Mus.*

II. Near Griff, *T. Kirk, Herb. Brit. Mus.;* Binley Bogs, *T. K.*, *Herb. Perry;* Ufton Wood.

PHRAGMITES.

P. communis, *Trin.* *Common Reed.*

Native: On river banks, near pools, and in damp shady places, &c. Locally abundant. August, September.

I. Near Sutton; near Polesworth; Bole Hall, Tamworth; Plant's Brook Reservoir; near Water Orton railway cutting; footway from Marston Green to Elmdon; Olton Pool; canal bank between Baddesley Clinton and Baker's Lane, near Knowle.

II. Honington; Tredington, *Newb.*, near Bilton! Wolston! *R.S.R.*, 1877; Alveston Pastures; Stratford-on-Avon; Oversley; Claverdon; Eastern Green, near Coventry; Kenilworth; Warwick; Tachbrook; banks of the Leam, Leamington; canal from Radford Semele, near Quinton Mills; Pool in Combe Abbey Grounds.

MILIUM.

M. effusum, *Linn.* *Wood Millet Grass.*

Native: In woods and on shady banks. Local. May, June.

I. Arley Wood; Kingsbury Wood; Bentley Park; Hartshill Hayes; Meriden Shafts; Spring Coppice, Hockley.

II. Ragley! and Oversley Woods! *Purt.*, i, 72; Haywoods; Honily, *Y. and B.*; near Guy's Cliff; Woodloes; Fern Hill Wood! Gilbert's Coppice, Rowington, *H.B.*; woods, Edge Hills; Alveston Pastures; Austey Wood, near Wootton Wawen; woods, near Claverdon; lanes about Lapworth; Haywoods; Quarry Lane, Rowington; Crackley Wood, Kenilworth; Cubington Wood; Brandon Wood; Combe Woods.

DESCHAMPSIA.

D. cæspitosa, *Beauv.* (*Aira cæspitosa*, L.) *Tufted Hair Grass.*

Native: Near rivers, streams, pools, drains, and on damp roadsides. Common. June—July. Area general.

A variety closely approaching var. *brevifolia* occurs in Sutton Park and near High-down, Tachbrook.

D. flexuosa, *Trin.* (*Aira flexuosa*, L.) *Heath Hair Grass.*

Native: on heaths, heathy roadsides, banks, and in open woods. Locally abundant. June, July.

I. Dry woods in Sutton Park! *With.*, ed. 7, 161. Middleton Heath; Trickley Coppice, New Park; Bentley Park; heath lands near Atherstone Outwoods; Baxterley and Baddesley Commons; Bannersley Rough; Coleshill Heath; Marston Green; Hampton-in-Arden; lanes about Solihull and Knowle; Hockley; Earlswood; Forshaw Heath.

II. Haywoods! *Y. and B.* Spinney between Blue Boar and Wolston! Near Overslade, Dunchurch Road; *R. S. R.*, 1877. Kenilworth; Oversley; Combe Woods, &c.

A form remarkably like the var. *b. montana* is occasional on exposed heath lands, Sutton Park; and a robust form with long ligule, but in other matters like the type grows in boggy and damp woods in Sutton Park and near Earlswood.

AIRA.

A. caryophyllea, *Linn.* *Silver Hair Grass.*

Native: On sandy heaths, roadsides, pastures, and banks. Local and rare. June, July.

I. Common about Edgbaston, *Freeman, Phyt.* i. Atherstone Outwoods, *Herb. Per.* Sandy banks, Gravelly Hill; roadsides near Wylde Green Railway; sandy waysides, Hill, near Sutton; Middleton Heath; Atherstone Outwoods; Coleshill Heath; Hill Bickenhill; Bannersley Rough; Hampton-in-Arden.

II. In Oversley Wood on a sandy bank, *Purt.*, i., 73. Milverton; Kenilworth, *Y. and B.* Yarningale Common! *H. B.* Near Brandon.

A. præcox, *Linn.* *Early Hair Grass.*

Native: On heaths and heathy roadsides. Local. April, May.

I. Roadside near Wylde Green Railway Station; Sutton Park; Middleton Heath; Hartshill Stone Quarries; Baddesley Common; Bannersley Rough; Coleshill Heath; Hampton-in-Arden; Forshaw Heath; Earlswood.

II. Whitnash; Tachbrook! *Y. and B.* Sandy field, Milverton, *H. B.* Kenilworth Heath.

TRISETUM.

T. flavescens, *Beauv.* *Yellow Oat Grass.*

Native: In meadows, pastures, and on roadsides and banks. Rather common. June, July.

I. Canal bank, Gravelly Hill; pastures near Sutton Park; Middleton; Ansley; Baddesley Ensor; Baxterley; Kingsbury; Coleshill; Marston Green; Solihull; Knowle; Temple Balsall; Earlswood, &c.

II. Sherbourn, *Y. and B.* Honington, Tredington, *Newb.*, Edge Hills; Kineton; Alveston Heath; Stratford-on-Avon; Binton; Wixford; Salford Priors; Oversley; Henley-in-Arden; Foleshill; Combe Fields, &c.

AVENA.

A. pubescens, *Linn.* *Downy Oat-Grass.*

Native: In pastures, heathy commons, and on roadsides in marly and calcareous soils. Locally abundant. May, June.

I. Slade Lane, Witton; pasture near Sutton; lane by Erdington Grange; Sybill Hill, near Kingsbury; Oldbury; Baddesley Ensor; Coleshill; meadows near Blythe Bridge, Solihull.

II. Myton, Chesterton! *Y. and B.* Tredington, *Newb.*, Wroxall; Longbridge, Warwick, *H. B.* Farnborough, near the village; Marl cliff, near Bidford; roadside between Alcester and Stratford; Bardon Hill; Foleshill.

A. pratensis, *Linn.* *Glabrous Oat Grass.*

Native: In pastures, and on roadsides and banks in calcareous soils. Rather rare. July.

I. Roadside near Bradnock's Marsh, June, 1882.

II. Lighthorne; Tachbrook; Compton Verney, *H. P.* Chesterton! *Y. and B.* Tredington! *Newb.* Oversley Hill, near the wood; Warwickshire meadows, Salford Priors; Marl cliff near Bidford; roadsides between Stratford-on-Avon and Drayton Bushes; pastures near Shottery; Bardon Hill.

[*A. strigosa*, Schreb. *Black Oat.*

Casual: In corn fields. Rare. July.

II. Casual about Myton, *H. B.* Moreton Morrell, in wheat fields.]
A casual of very uncertain occurrence.

A. fatua, *Linn.* *Wild Oat.*

Colonist: In corn and other cultivated fields. As an aggregate species locally common. July.

a. pilosissima. Rather common.

I. Long Lane, Sutton; near Over Green, Wishaw, Curdworth; Hartshill; Coleshill; Marston Green.

II. Whitnash; Tachbrook, *Y. and B.* Lambcote; Stratford-on-Avon *Newb.* Wixford; Binton; Exhall; Alne Hills; near Rugby.
b. intermedia. Local or rare.

II. Myton, *H. B.*, Alne Hills; Spernall Ash.
c. pilosa. Rare.

II. Harbury, *H. B.*! Cultivated fields near Stratford-on-Avon.
The two latter varieties have probably a more extended range than is given here, but sufficient attention has not been given to them to allow of fuller record.

(To be continued.)

Reviews.

Magnetism and Electricity. By Professor F. GUTHRIE. New edition, revised by Mr. C. V. Boys; 428 pp., 323 illustrations. Published by W. Collins and Sons; price 3s. 6d.

THE large circulation of Professor Guthrie's book—it has now reached its twentieth thousand—is the natural result of the high merit of the book and its low price. To the present edition Mr. Boys has added a valuable chapter dealing with electrical measurements and with the wonderful discoveries which have rendered the last few years famous in the history of electricity.

The Student's Elements of Geology. By Sir C. LYELL. Fourth edition, edited by Professor P. M. DUNCAN. 621 pp., 8vo.; 636 woodcuts; price 9s. Published by J. Murray.

STUDENTS will hail with pleasure the appearance of a new edition of "Lyell's Elements," a standard work which has been out of print for several years. It has been revised with great care by Prof. Duncan, who has incorporated with the book the most recent geological discoveries, including even Prof. Geikie's acknowledgment of the true arrangement of the rocks of the Highlands, a statement only published a few weeks ago. The illustrations, which are very numerous, appear to have been re-drawn, as they are as fresh as those of the first edition. The Table of British Fossils given in the appendix, which extends over twenty-two pages, and shows at a glance the successive appearance and development in time of the chief orders, classes, or families of animals and plants, is a valuable feature. There can be no doubt but that this book still remains the best general text-book of geology—considering its fullness of detail, the fact that it is contained in one volume, and its moderate price. W. J. H.

METEOROLOGICAL NOTES.—DECEMBER, 1884.

The barometer was unsteady throughout the month—fluctuating between 29·1 inches and 30·1 inches until the 20th, when it fell to 28·857 inches, and rose in forty-eight hours to 30·311 inches, remaining high during the remainder of the month. Temperature was about the mean, and was variable in the earlier part of the month. The highest maxima were 57·7° at Hodsock, on the 13th; 54·2° at Loughborough, 54·0° at Henley-in-Arden, and 53·3° at Coston Rectory, on the 6th; and 52·8° at Strelley, on the 13th. In the rays of the sun 84·2° was registered at Hodsock, on the 13th; 76·9° at Loughborough, on the 5th; and 72·3° at Strelley, on the 7th. The lowest minima occurred on the 31st, and were 22·0° at Coston Rectory, 23·3° at Hodsock, 24.0° at Henley-in-Arden, 24·6° at Loughborough, and 25·6° at Strelley. On the same date the thermometer on the grass recorded 18.7° at Strelley, 19·4° at Hodsock, and 21·7 at Loughborough. The rainfall was below the average, and consisted of small amounts. The 12th and 15th were the only days before the 21st on which there was not a fall of 0·01 of an inch or more. The latter portion of the month was generally dry. The total values were 2·58 inches at Henley-in-Arden, 2·19 inches at Strelley, 2·06 inches at Coston Rectory, 2·01 inches at Loughborough, and 1·45 inches at Hodsock. The heaviest fall in one day was 0·44 inches at Coston Rectory, on the 18th. Snow fell on the 1st, 17th, 18th, and 20th. At Loughborough a lunar halo was seen at 6 a.m. on the 8th, and on the afternoon of the 18th lightning and thunder were observed, and distant lightning in the evening of the same day. Sunshine was deficient. Gales, chiefly S.W., were experienced on the 2nd, 7th, 10th, and 18th.

WM. BERRIDGE, F.R.Met.Soc.

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Natural History Notes.

BRITISH MOSS FLORA.—In the notice of this work, Vol. VIII., p. 25, it should have been stated that Part X. will conclude Vol. I., not Part IX., as there stated.

FLORA OF DERBYSHIRE.—The Rev. W. Hunt Painter, has for some time past been engaged in preparing a new Edition of his "Notes on the Flora of Derbyshire," and has made numerous additions thereto both of Plants and Habitats. It will be issued to subscribers, as soon as printed, at 2/6 per copy. Subscribers' names may be sent to Messrs. Wright, Dain, Peyton, and Co., "The Herald Press Office," Birmingham.

OBJECTS FOR THE MICROSCOPE.—Messrs. James Carter and Co., 237, High Holborn, London, W.C., announce in their new seed catalogue for the present year that they are prepared to supply curious seeds for microscopic objects to those who desire them, at the following rates:—12 varieties for 2s. 6d., 25 for 5s., 50 for 10s. 6d., and 100 for 21s. This is the first occasion on which, so far as we know, such an offer has been made by either of our largest seedsmen, who must have unusual facilities for supplying the microscopist with many interesting opaque objects.

ADDITIONS TO THE FLORA OF SUTTON PARK.—I am pleased to say that two very interesting additions to this flora—as recorded in the "Notes on the Flora of Sutton Park"—have been made, namely, *Wahlenbergia hederacea* and *Lycopodium clavatum*. *Wahlenbergia hederacea* has been found associated with *Anagallis tenella* in several places by my kind friend Mr. A. W. Wills. This is a very pleasing addition and one that I had always expected would be found in this locality, as there are in this place all the natural surroundings required by such a plant. *Lycopodium clavatum* has also been found in this locality by Miss Ethel Stone, of Erdington, a young lady who takes great interest in botanical science, and whose more keen observation has enabled her to find a plant for which I have searched hitherto in vain. *Lycopodium clavatum* is recorded for "Sutton" by Samuel Freeman in the "Phytologist" for July, 1842, page 262, but as Miss Stone had never heard of this record her discovery of the plant in Sutton Park is as truly an original one as was Freeman's. When the "Notes on the Flora of Sutton Park" was published I was not aware of the existence of Freeman's paper, hence was unable to acknowledge—as I should gladly have done—his priority of record in the case of some of the rarer plants I have therein recorded. J. E. BAGNALL.

THE JACKDAW.—It may be interesting to some of your readers to know that a pair of jackdaws located themselves for a time in the very heart of the busiest part of Birmingham. In the spring of last year these birds took possession of the elevated spire of the Cobden Coffee House, in Corporation street. During the nesting season it was most amusing to see the way in which the birds supplied themselves with building material. From daylight until about 8 a.m. the pair were engaged in collecting sticks, &c., which were deposited on the roof of an adjoining building. The remainder of the day was occupied in carrying supplies from the store to the nest. Occasionally the birds would perch on the vane—one at each end—and on a windy day the vane would actually go round without at all disturbing the occupants of this exalted position. Though the nest was prepared, and one or other of the birds was to be seen daily during the period of incubation, it is somewhat doubtful whether young birds were hatched. It was not until September that any increase in numbers was noticed; but on this occasion there was considerable commotion round the spire, four pairs of birds being observed, all apparently making a careful examination of the amount of accommodation available for another season. It would be interesting to know the district from which these jackdaws came, and why they selected a place so far from any feeding ground. It appears somewhat remarkable that they should have selected this new spire in preference to the larger and older building of St. Philip's Church, which is only about a hundred yards distant. At the present time (January) the place is visited daily for about two hours by one pair of birds only. W. H.

NITRATES.—Of the salts just mentioned, the nitrates are of extreme importance, inasmuch as nitrogen is an essential constituent of protoplasm—without nitrogen there can be no protoplasm, without protoplasm there can be no plant. The nitrogen is supplied to the plants from the soil in the form either of nitrates (potassic nitrate, sodic nitrate), or of ammonia salts in which the nitrogen is in combination with hydrogen. The ammonia in the soil is made to combine with oxygen, and thus to form nitric acid, through the agency of minute organisms called "Bacteria," which, like the yeast fungus, act as ferments; and by their agency it is, as Mr. Warington has pointed out, in confirmation of the researches of Schloesing and Muntz, that the ammonia salts, which themselves are inert, or it may be harmful, get converted into useful nitrates. Ammonia salts applied to some soils do no good, because the needful germs or ferment bodies are not present in the soil; but where they do exist, they convert the useless into the useful, as before said. These bacteria occur in all fermenting material, such as farmyard dung, whose value as manure is in part accounted for by their presence and agency. It is probable in the future that just as the brewer uses his yeast to secure the conversion of starch into sugar, and the chemist "seeds" his solutions to effect the changes he wishes to bring about, and just as the gardener sows the spawn or germs of mushrooms in his mushroom bed, and obtains thereby a crop of succulent fungi, so the farmer may be able to apply to the soil the ferment-producing germs needed to change its quality, and render it available for plant food. When we have arrived at that point, manuring will be reduced to a science, and a pinch of the right material will be as efficient as a ton of our present compounds, the larger part of which are undoubtedly wasted under existing circumstances.—Dr. MAXWELL T. MASTERS, F.R.S., in his "*Plant Life*." (London: Bradbury, Agnew, and Co.)

How and Why.—No torn scrap of that very sea-weed, which to-morrow may manure the nearest garden, but says to us, "Proud man! talking of spores and vesicles, if thou darest for a moment to fancy that to have seen spores and vesicles is to have seen *me*, or to know what I am, answer this. Knowest thou how the bones do grow in the womb? Knowest thou even how one of these tiny black dots, which thou callest spores, grow on my fronds?" And to that question what answer shall we make? We see tissues divide, cells develop, processes go on—but how and why? These are but phenomena; but what are phenomena save effects? Causes, it may be, of other effects; but still effects of other causes. And why does the cause cause that effect? Why should it not cause something else? Why should it cause anything at all? Because it obeys a law. But why does it obey the law? and how does it obey the law? And, after all, what is a law? A mere custom of Nature. We see the same phenomenon happen a great many times; and we infer from thence that it has a custom of happening; and therefore we call it a law: but we have not seen the law; all we have seen is the phenomenon which we suppose to indicate the law. We have seen things fall: but we never saw a little flying thing pulling them down, with "gravitation" labelled on its back; and the question, *why* things fall, and *how*, is just where it was before Newton was born, and is likely to remain there. All we can say is, that Nature has her customs, and that other customs ensue, when those customs appear: but that as to what connects cause and effect, as to what is the reason, the final cause, or even the *causa causans*, of any phenomenon, we know not more but less than ever; for those laws or customs which seem to us simplest ("endosmose," for instance, or "gravitation") are just the most inexplicable, logically unexpected, seemingly arbitrary, certainly supernatural—miraculous, if you will; for no natural and physical cause whatsoever can be assigned for them; while if anyone shall argue against their being miraculous and supernatural on the ground of their being so common, I can only answer, that of all absurd and illogical arguments, this is the most so. For what has the number of times which the miracle occurs to do with the question, save to increase the wonder? Which is more strange, that an inexplicable and unfathomable thing should occur once and for all, or that it should occur a million times every day all the world over?—Charles Kingsley.

Mr. James E. Bagnall.—Mr. Smiles, in his charming "Life of a Scotch Naturalist, Thomas Edward, Associate of the Linnean Society," has told the history of one of the most zealous naturalists that ever lived—a man who, under the most adverse circumstances, made great and important additions to natural knowledge. In 1866 these arduous labours were signally recognised and, in a sense, rewarded by his being elected an Associate of the Linnean Society. The society never has more than twenty-five Associates on its roll of members, and Edward's biographer very accurately says of him when he became one of the number, that it was "one of the highest honours that science could confer upon him." Not only is it an honour to be elected an Associate, but the honour is all the greater inasmuch as no one is elected who has not done some really good work in at least one branch of Natural History. It is, therefore, a source of much pleasure to us to be able to announce that this honourable distinction has lately been conferred on our much-respected contributor, Mr. James E. Bagnall, of Birmingham, who, at a recent meeting of the Linnean Society, was unanimously elected an Associate, the proposition being made, seconded, and supported by several eminent scientific men. Mr. Bagnall is one of the Vice-Presidents of the Birmingham Natural History and Microscopical Society, of which he has for something like a quarter of a century been one of the most useful and hard-working members. He has devoted his principal attention to the study of botany—structural and systematic. Years since he won for himself a name as a bryologist. He has communicated numberless papers to the Society, and scarcely a meeting has taken place for a very long period at which he has not exhibited some plant "new to the district" or of great rarity. He has always been a ready helper to young beginners, and many local botanists have benefited by his assistance. Many of his contributions have appeared in the scientific journals. His most important published work is the latest and by far the best "Flora of Warwickshire," which has appeared by instalments extending over several years in the pages of this magazine. This important work will, we are informed, shortly appear in a thoroughly revised form as an independent publication. We cannot entertain a doubt that it will be warmly welcomed by botanists in all parts of the kingdom, for it has already won the reputation of being one of the fullest and most carefully prepared county floras in the English language. If we are not misinformed, Mr. Bagnall has achieved his success as a scientific man in the leisure hours of a working life spent in one of our large manufactories, where he has been as "diligent in business" as he has been diligent in observation and study when the day's work has been finished.

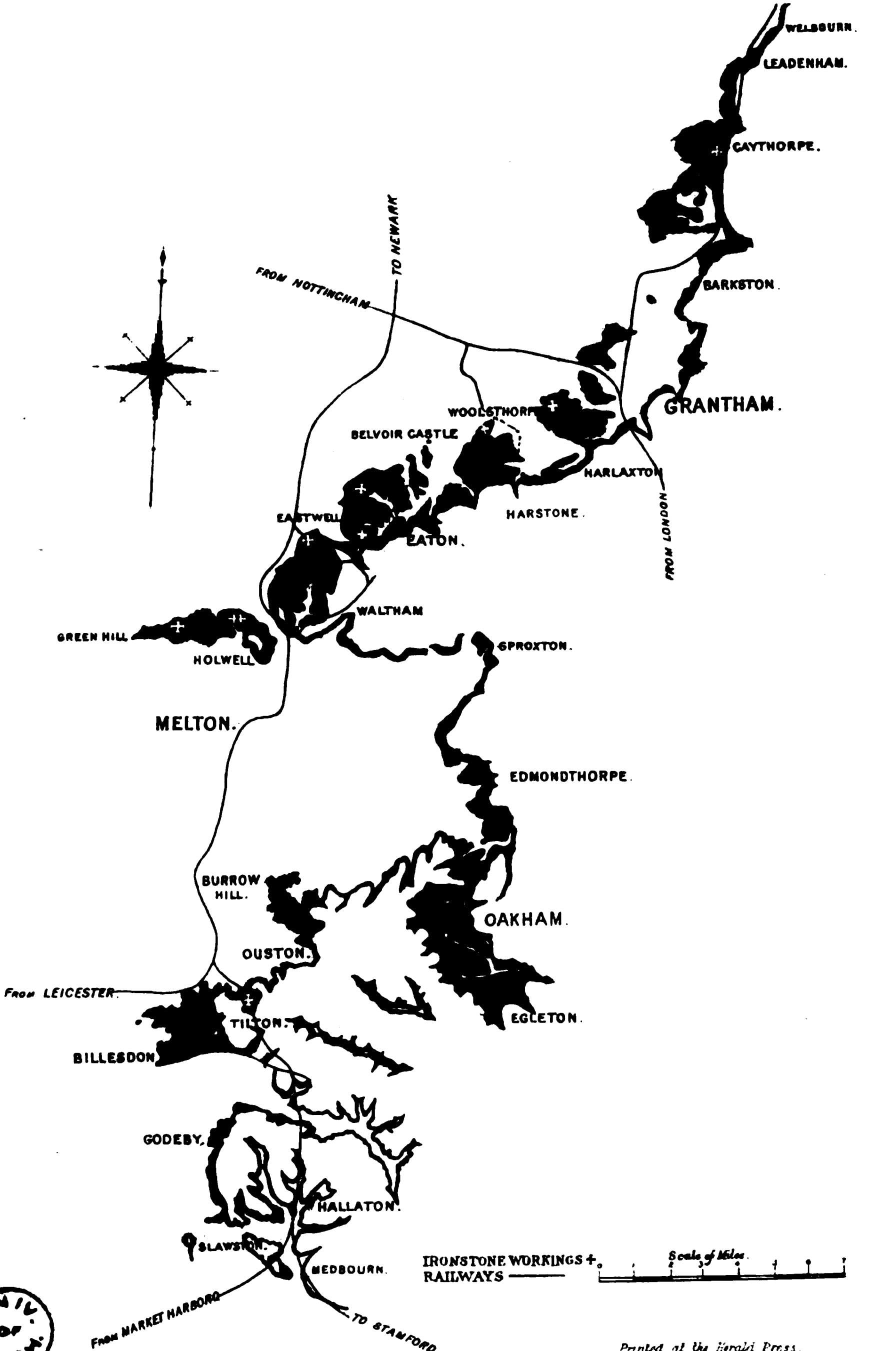
Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical General Meeting, January 20th, 1885.—The following resolution was passed:—"That this meeting desires to express its sincere sorrow and regret at the loss which the Society has sustained by the death of their Assistant Curator, Mr. Cox, who fulfilled the duties of his office with satisfaction to the Society, and advantage to the members; and this meeting further desires to express its sympathy with Mr. Cox's relatives on this occasion." Mr. W. R. Hughes, F.L.S., exhibited *Arbutus unedo*, in flower and fruit, from Colwyn Bay, North Wales. Mr. W. H. Wilkinson exhibited *Glyceria fluitans* from the warm water of a canal at a Wolverhampton Iron Works. Also some large acorns from a tree near the Wrekin, Shropshire, probably *Quercus albus*, an American species of Oak, brought into cultivation here about 1793. Mr. R. W. Chase exhibited rare varieties of the following birds:—Variety of *Fringilla cœlebs*, from Small Heath; *Sylvia cinerea*, from Tamworth; *Erithacus rubecula*, from Burton; *Sturnus vulgaris*, local; *Tringa minuta*, from Breydon Broad; also nests and eggs of *Erithacus rubecula*, *Anthus obscurus*, *Fringilla cœlebs*, *Motacilla raii*; and clutches of eggs of *Accipiter nisus*, and *Larus fuscus*. All the above eggs were of unusual colouring. Mr. W. B. Grove, B.A., exhibited under the microscope, Koch's Comma Bacillus, from a specimen cultivated in gelatine, put up by Dr. Strauss, of the German Cholera Commission. This is the alleged germ of cholera, and there is great probability that the allegation will be proved. The opinions which have been expressed against it are all unsupported by trustworthy experiments. In opposition to Professor Ray Lankester's published opinion, it may be stated that these specimens are comma-shaped, *i.e.*, curved in a sixth of a circle, but of course without the head, and also are a true species of Bacillus in the vibrio form.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 22nd.—Mr. Deakin exhibited specimens of land shells of the following genera:—Helix, Clausilia, and Bulimus, from Mount Carmel, Palestine; also carvings in soapstone, from Agra and Ceylon. Mr. Moore, a collection of named marine shells from Ceylon. Mr. Madison, the following shells:—*Helix irce*, from Queensland; *H. pennsylvanica*, from Ohio; and *Planorbis corneus*, from Slavonia. Mr. J. W. Neville, Permian marl, with fern impressions. Mr. J. Betteridge contributed his fourth paper on "Birds of the District." January 5th.—Mr. Moore exhibited a collection of foreign shells, *Cypræa caurica*, *C. andria*, *C. caput-serpentis*, etc., etc. Mr. Madison, *Unio luteolus* and *Anodonta subcylindrica*, from United States. Mr. Hawkes, a specimen of Pinnothere from shell of mussel. Under the microscope Mr. Dunn showed *Canthocamptus minutus*. Mr. J. W. Neville, Foraminifera, dredged off coast of Galway. January 12th.—Mr. Moore exhibited specimens of *Nerita virginea* and other foreign shells. Mr. Hawkes, a collection of plants from Llandudno, including *Echium vulgare*, *Statice Limonium*, and *Gentiana Amarella*. Under the microscope Mr. J. W. Neville showed a polyzoön, *Membranipora membranacea*, from New Zealand.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S.; monthly meeting, January 21st; attendance, twelve (four ladies). Exhibits: Fruit of the Mango (*Mangifera indica*) and the Butter-nut (*Caryocar nuciferum*) by the Chairman. Branch of *Ribes speciosum* from a garden in Hampshire, showing its numerous triple spines and young winter leaves, by Miss Grundy. The large common lichen, *Peltigera canina*, with abundant fruit, by Mr. Grundy. Papers (1), by Mr. F. Bates "On two rare filamentous algæ new to the county," viz., *Œdogonium platygynum* and *Œ. ælandicum*, the former only recorded hitherto from Ireland, and the latter entirely new to Great Britain. These very interesting plants Mr. Bates had discovered in bogs and pools on Charnwood Forest, and he exhibited under the microscope admirably prepared slides showing the oögonia in several stages, and with the dwarf males attached. The paper described the extraordinary and complex process of fecundation in this remarkable group. (2) By Mr. H. G. Quilter, "On some Analogies between Plant and Animal Life," showing how both originated from the simple cell, how the processes of development were nearly similar in each case, and how all the attributes and functions of animals might be traced in plants also, only in a less advanced stage, and on a lower level. (3) By Mr. F. T. Mott, "On *Acaulon (Phascum) muticum*, one of the smallest Leicestershire mosses." This minute moss, one-twelfth of an inch in height only, he had found in his own garden in company with *Phascum cuspidatum* and *Pottia truncata*. It had only once before been recorded for the county, viz., by the Rev. A. Bloxam at Congerstone. Several specimens were exhibited prepared as microscopic slides by Mr. J. H. Garnar, also some specimens of the smallest flowering plant, *Wolffia arrhiza*, for comparison of size. This small moss was specially notable for its beautiful little bright red globular capsule.

Plate II.



Printed at the Herald Press.

MAP OF THE LIAS MARLSTONE ROCK IN THE LEICESTERSHIRE DISTRICT.

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

The *Marlstone Rock* or *Rock Bed* is a hard, ferruginous, earthy, and highly fossiliferous limestone, passing into an ironstone, which lies in the midst of the softer shales of the Lias formation. It constitutes the upper member of the Middle Lias series, the lower member comprising a series of sandy shales, which graduate into the underlying clays of the Lower Lias.

From the large amount of iron it contains, the Marlstone Rock has during the past ten or twelve years acquired a considerable commercial importance, and the mining industry to which it has given rise in the Leicestershire district is, without a doubt, destined in the future to attain far greater dimensions than it has at present reached. In times long passed, and of which we have no historical record, the rock bed was worked for iron both in Leicester and Rutland, as is evidenced by the ancient slags which are occasionally met with. Having fallen into disuse, however, its value as a source of iron has been, until quite recently, either entirely overlooked or altogether underestimated. For many years past it has been quarried for building, road metalling, and lime burning, and for all of these purposes it is still to a certain extent used. During the construction of the new local lines of the Great Northern Railway Company, the Marlstone met with in the cuttings proved of considerable service both for the building of bridges and the ballasting of the line.

The rediscovery of the Leicestershire ironstone in modern times appears to have been made by Mr. I. A. Knipe, who also constructed a geological map of the Belvoir district where the ore occurs, and brought it to the notice of the Duke of Rutland. This was prior to 1855, in which year a trial of the marlstone from Croxton was made at the furnaces of the Clay Cross Company. At that period, however, there were no means of getting the stone away, and it was mainly on that account, I believe, that no further steps were then taken in the matter. To Mr. R. Dalgliesh, manager of the Holwell Iron Company, and Mr. H. A. Allport belongs the credit of having been the first to actually commence the working of the Leicestershire Marlstone for iron, and thus to give the ore a commercial value. Mr. Dalgliesh, while employed on the parliamentary survey of the Nottingham and Melton line for the Midland Railway Company, was struck by the redness of the ground in the neighbourhood of Holwell, and concluded that there was iron there. In the year 1873 Messrs. Dalgliesh and Allport examined the district. Samples of the Holwell ironstone were procured and sent to Mr. E. Riley, F.C.S., of London, to be analysed, and that gentleman gave a very favourable report of the stone. A large sample of the ore was in the following year sent to Staveley to be smelted. The result proved the correctness of Mr. Riley's opinions, the stone turning out easy to smelt, and the pig-iron produced from it being of good quality. In 1875 a company was formed and a lease of the ironstone obtained. In the following year a mineral branch line was constructed from Holwell to the Midland Nottingham and Melton line near Asfordby, and the district was thus opened out, and the ironstone got into the market. At first the Holwell Company sent the whole of their ore to the Staveley Company and other large iron smelting firms in Derbyshire and elsewhere. In 1881 they erected a couple of furnaces at Asfordby, near Melton Mowbray, and since that year they have smelted the bulk of the ironstone they have got in the district at their own works. At the present time they have a third furnace ready to put into blast. These, it should be mentioned, are the only furnaces in the Leicestershire ironstone field, and at Asfordby the manufacture of iron is carried on with due regard to the most approved scientific methods.

The Marlstone Rock as a formation—though not for the whole distance as an available source of iron—extends uninterruptedly through the district for a distance of thirty-five miles, namely, from Welbourn in Lincolnshire, on the north, to Medbourn, near Market Harborough, on the south. Within these limits its prevailing north-easterly strike varies somewhat, whilst its thickness varies very considerably. Owing to these causes and to subsequent unequal atmospheric denudation, as also to the effects of at least one considerable fault, its outcrop is extremely irregular. The maximum thickness of thirty feet is attained in the middle part of its range, or between Barrowby, near Grantham, and Scalford, near Melton. When followed north and south of these two points, the Marlstone is found at first gradually, and then more rapidly to thin away and eventually to die away altogether.* Hence, we may look upon the Leicestershire

* The Marlstone also displays a tendency to attenuate in an easterly direction.

Marlstone as a lenticular mass of rock enclosed in the Lias shales. From its superior hardness, the Rock-bed has been able to withstand denudation to such an extent that, when well developed, it forms an elevated table land or terrace from half a mile to two miles in width, rising with a gentle inclination from the base of the slopes of the Upper Lias shales on the east, and terminating in a bold escarpment overlooking the Lower Lias country on the west. This escarpment has in many places become deeply indented by valleys, and carved into promontories and even outliers through the wearing action during the course of ages of the many streams that breach its face. The porosity and extensive jointing of the exposed Rock-bed, which rests upon comparatively impervious clays, render it a copious reservoir for water. Most of the brooks of the adjoining Lower Lias district take their origin in springs thrown out at its base.

The Marlstone Rock shows great variations in mineral character. When quarried in an unweathered state in deep pits or under beds of impervious clay, it is a hard crystalline rock of a bluish-green tint, but where it has for a length of time been exposed to the disintegrating influences of the atmosphere it becomes, owing to chemical changes to be hereafter explained, of a rusty brown colour, and porous and friable in texture. At the surface the marlstone breaks up into a very characteristic deep red ferruginous soil, which forms an excellent corn land, and contrasts in a marked manner with the pasturage of the adjoining country occupied by the heavy clays above and below. Trees attain a large growth on this rock, and root-crops, as well as all the cereals, thrive upon it.

In a general way the Marlstone Rock consists of two very distinct portions—an upper and a lower—each of which constitutes, roughly speaking, about half its entire thickness. When the rock is in an unweathered state, this distinction is not very obvious to the eye, though it comes out on analysis. In the brown or weathered condition, however, the difference of these two portions is readily discerned. The upper part then appears as a highly ferruginous laminated limestone, the lower as massively bedded, but softer and more or less concretionary sandstone. It is a noteworthy fact that only the *upper* portion of the Marlstone is sufficiently rich in iron to pay for working, so that even when that rock attains a thickness of twenty-five feet or more the ironstone beds actually worked will not at the outside exceed some eight or ten feet. If then these upper beds are absent, the Marlstone will be unproductive of iron. Some beds of the Marlstone are crowded with fossils, though they belong as a rule to a very limited number of species. These beds, termed "Jacks" by the quarrymen, are made up of an agglomeration of the shells of Rhynchonella tetraedra and Terebratula punctata, associated with which we also find Belemnites paxillosus and Belemnites elongatus. The latter forms serve to distinguish the Lias marlstone from the Northampton Sands ironstone, to which it bears a considerable lithological resemblance, but from which it is both geologically and mineralogically quite distinct. Certain beds are almost entirely composed of encrinite fragments or of broken shells. Now and then an Ammonites spinatus will turn up, but this, the characteristic fossil of the Marlstone horizon, is in the Leicestershire district generally characteristic by its rarity or entire absence. The bottom bed of the Marlstone usually contains small flattish phosphatic nodules in such numbers as to give the rock a conglomeratic aspect.

Having described the general features of the Marlstone Rock, as exhibited in the counties of Leicester, Rutland, and (South) Lincoln, I will now proceed to notice in somewhat greater detail its varying character and thickness, and in particular its mineral products and organic remains within the limits of the above district. For convenience we will commence in the centre of Rutland, a typical Marlstone country, and thence trace the rock southwards towards Northamptonshire, and northwards into Lincolnshire.

In the neighbourhood of Oakham the Rock-bed, though only eight or nine feet in thickness, covers a very extensive area of low-lying ground forming the floor of the famous Vale of Catmos. Its decomposition gives rise to the highly productive red soil for which this district is renowned, and which probably gave the name Rutland (Red-land) to the county. A little further to the south this rock may be seen forming terraces on the sides of the valleys of the Chater and Gwash. To the north of Oakham, about Teigh, Edmondthorpe, and Wymondham, the Marlstone Rock stands out as a bold escarpment on the west, with a gentle dip-slope to the east. Going westwards from here we find the Rock-bed stretching out by Whissendine and Pickwell to terminate in the bold promontory of Burrow-on-the-Hill. This district, diversified as it is by deep valleys and surmounted by the cliff-like masses of the Rock-bed, displays hereabouts really picturesque scenery. Bending round by Somerby and Ouston the Marlstone sends out another fine branch by Tilton to Billesdon. This western projection of the Marlstone is due to the preservative influence of the great Billesdon and Lodington fault, which has a downthrow to the north of fully 150 feet. In this neighbourhood, the Marlstone attains more than twice the thickness it exhibits in the Oakham district. In the vicinity of Tilton there are several interesting exposures of the Marlstone Rock. It is finely displayed in the railway cutting south of Tilton Station in its grey unweathered form beneath a thick capping of Upper Lias shales, and in this section its junction with the underlying Middle Lias shales is well shewn.

Section in railway cutting south of Tilton Station.

			Ft.	In.
	Upper Lias Shales, in grass-grown slopes, about ...		30	0
	Middle Lias: Marlstone Rock—			
(*h.*)	Bluish-green calcareous ironstone, massively bedded with an irregular flakey capping containing Nautilus truncatus, Ammonites acutus (in great numbers), A. spinatus, A. communis, A Holandrei, A. serpentinus, A. annulatus, A. Cœcilia, Belemnites elongatus, B. paxillosus, B. apicicurvatus, Lima pectinoides, Pecten æquivalvis, Cerithium ferreum, C. confusum, C. reticulatum, Eucyclus Gaudryanus, Phasianella turbinata, Trochus ariel, T. æolus, Cryptænia expansa, Plicatula spinosa, Rhynchonella tetraedra var. Northamptonensis, Terebratula punctata, and var. and occasionally fragments of fossil wood	0 6 to 0 9		
	passing down into dark bluish-green calcareous ironstone finely oolitic, containing Am. communis, A. acutus, Pecten lunularis, P. æquivalvis, Terebratula punctata, Belemnites	2 8	3	2
(*g.*)	Grey finely oolitic calcareous ironstone, Pecten lunularis, Belemnites		1	7
(*f.*)	Encrinital bed, grey finely oolitic rock, obliquely laminated with encrinital fragments, Belemnites	0 6	1	0
(*e.*)	Bluish-green oolitic rock, with irregular seams of encrinital fragments, Belemnites ...		1	2
(*d.*)	Bluish-green finely oolitic rock, with encrinite fragments, Pecten lunularis, P. æquivalvis		2	0
(*c.*)	Bluish-green rock, becomes locally a "jack," Pecten æquivalvis, Belemnites, Rhynchonella tetraedra, Terebratula punctata		1	6

(*b.*) Greenish arenaceous rock, locally a "jack" in upper portion, Belemnites, Terebratula punctata, and Rhynchonella tetraedra. The lower portion of this bed is nodular and veined with calcite	4	6
(*a.*) Greenish arenaceous rock, with "jack" in upper half; the lowest six inches contain many phosphatic nodules, Gresslya lunulata, G. intermedia, Pleuromya sp. Rhynchonella tetraedra, and Terebratula punctata... ...	3	6
	18	5
Middle Lias: Shales—with bands of sandstone and scattered limestone nodules ... (exposed)	13	0

The dip is here very well shewn. It is about 1° in a S.E. direction.

NOTE.—The Marlstone Rock is traversed by numerous joints. Along these fissures as also along the bedding planes the iron carbonate has, to the depth of a few inches on either side, become converted into the hydrated oxide, causing the stone to assume a yellowish brown colour.

The uppermost stratum, or rather the top layer of this stratum is remarkable for the organic remains it contains. Of these, one of the Ammonites, A. acutus, is especially noticeable, for it occurs in great numbers and in all stages of growth, yet not a single individual has ever been found elsewhere in the district. In addition, we find several other Ammonites and some interesting little Gastropoda, as well as ordinary bivalves and Brachiopoda. This top bed, or at any rate the special fauna it contains, is extremely local, being, so far as I know, limited to Tilton. On the north side of Robin-a-Tiptoes there is a brickyard section which exposes the upper beds of the Marlstone Rock and its junction with the Upper Lias shales; but although this point is only half-a-mile from the Tilton section we see no trace of the A. acutus bed.*

* A somewhat similar fossiliferous bed, containing some Upper Lias forms, has been noticed at the top of the Marlstone of Oxfordshire by Mr. Beesley, of Banbury, and is considered by him to be a passage bed to the Upper Lias. The A. acutus band at Tilton, however, although it contains certain Upper Lias forms, cannot properly be considered a passage bed.

(*To be continued.*)

ON "THE NERVOUS SYSTEM OF VEGETABLES.—DO PLANTS FEEL?"*

BY F. T. MOTT, F.R.G.S.

It is well known that many plants possess, in some of their organs and tissues, a certain irritability by which various functional movements are set up and regulated. The folding leaves of sensitive plants, of which there are many; the sleep of plants, the twisting petioles and tendrils of climbers, the fly-traps of Drosera and Dionæa, the sensitive anthers of the Barberry, are familiar examples of this irritability which induces motion. But how is the motion produced? and what is the fundamental cause concealed under the term "irritability"?

These movements, which are all curvilinear, and represent the bending of some organ to one side, may arise either from the contraction of tissue on the inner side or from its expansion on the outer side. In the common sensitive-plant it is believed by Sachs that the leaf movements are caused by a sudden rush of liquid from the cells on one side of the articulation to those of the other side, which become at once turgid and enlarged, and bend the leaf over towards the empty cells. But in curving stems and tendrils Asa Gray has shown that if a slice is cut off the convex side, so as to make it thinner, the bending is more rapid, which shows that it is due to the contractions of cells on the inner side, not to the expansion of those on the outer.

Here, then, is something approaching to true contractile tissue, that tissue which constitutes the active muscles in the higher animals. But such animal muscle contracts only at the bidding of some delicate nerve fibre, and no such fibre has anywhere been found in the Vegetable Kingdom.

There are, however, among the lowest orders of animal life many examples of a contractile tissue which operates in the same manner as the muscles of the higher animals, and yet is not controlled by any discoverable system of nerve fibres. The Amœba has no nerves, yet it moves about apparently at its own will. The Medusæ swim by contractions of the gelatinous bell, and according to Mr. G. J. Romanes irritation is conveyed from side to side of this bell, yet no trace of nerve fibre can be found in it.

Surely, then, we may be justified in attributing the contraction of vegetable tissue to a power the same as, or

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read June 20th, 1883.

analogous to, that which contracts the tissue of the lower animals. What is this power?

In organic structures we may recognise four fundamental systems of tissue, viz.:—

The soft cellular tissue,
The hard bony tissue,
The contractile muscular tissue, and
The energy-conveying nerve tissue.

In the highest animals we find all those systems well developed. As we descend the scale we find them fading out in the order in which I have placed them. First the nerve tissue diminishes, then the muscular, then the bony, till the lowest organic forms consist of soft cells only.

But since, according to the laws of organic Evolution, the highest forms have been developed from the lowest, the capacity for this development must exist in those lowest forms, in the same manner as the capacity to develop into an oak exists in the acorn. In fact, the first embryonic form, even of man himself, is still a single cell.

Now in the Vegetable Kingdom we find that the first two systems of tissue are well developed, the cellular and the bony. The third system—that of the laminated and contractile muscle, is imperfectly represented by the foliage which clothes the hard skeleton and with which most of the contractile movements are connected; but the last and highest system, that of nerve tissue, is quite undeveloped.

The laws of true analogy, however, suggest the immense probability that this is only one of the regular phenomena of organic development; that the form of vital energy which constitutes thought and sentiment in man and which represents itself in the material world by nerve tissue, exists throughout the descending scale of life in a gradually less developed condition till in the Protozoa and Radiata among animals, and in all vegetables, it is so completely embryonic that it is not represented to our senses by any differentiated tissue.

From this point of view irritability in plants is seen to have precisely the same origin as in animals.

It is a nervous phenomenon; the result of nerve energy in its lowest form acting through contractile cells. In the most general sense the plant "feels" in the same way that the animal does, but probably in the most general sense only. No man can absolutely say what amount of *consciousness* of feeling may exist in any creature other than himself. But all the evidence we can gather points to the conclusion that consciousness is one of the highest conditions to which nerve energy attains, that it becomes continually less definite along the descending scale of life, and that in cellular animals and all plants there exists only a faint trace of it, or none.

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(*Continued from page 40.*)

2.—*The Syenites of South Leicestershire.*—The little bosses of syenitic or dioritic rocks which crop out in South Leicestershire have been so recently described by me in the "Midland Naturalist,"* that I need not now allude to them in detail. They are largely worked for paving-setts, &c., at Enderby, Narborough, Croft, Stoney-Stanton-with-Sapcote, and Barrow Hill—little villages lying on either side of the railway from Nuneaton to Leicester. In most of the stone-pits the Keuper marls and sandstones are well exposed, resting upon the eroded surface of the igneous rock, and showing in a striking manner the difference between stratified and unstratified rocks. The microscopic character of the syenite proves it to be allied to the Charnwood rocks of the same character. At one point (the lower quarry at Enderby) the syenite is seen to break through a dull green slaty rock. This slate was assigned by the discoverers of the section (the Revs. E. Hill and T. G. Bonney) to the Charnwood series, but I believe that it is of later date, forming part of the Cambrian formation, which probably encircles Charnwood on all sides, although its junction with the older rocks is (in that district) everywhere covered over and concealed by newer strata.

But if Charnwood rocks themselves are not exposed in South Leicestershire these four or five low round-topped hills afford valuable evidence of an extension of the Pre-Carboniferous rocks for at least nine miles in a southerly direction.

3.—*The Pre-Cambrian and Cambrian Rocks of the Hartshill Range.*—Walking south-west from the hummocky rocks of Croft and Sapcote across the Triassic plain of South Leicestershire, we soon arrive at the foot of a well-defined ridge, which extends from Nuneaton, by Hartshill, to beyond Atherstone, a distance of six or eight miles. The rocks forming this ridge have a strike in strict accordance with its extension from north-west to south-east, and they dip to the south-west at high angles—from thirty to sixty degrees—rising abruptly from the Leicestershire plain on the one

* Vol. VII., pp. 7 and 41.

hand, but gradually sloping to the higher surface of the Warwickshire coal-field which lies to the west and south. The altitude of the ridge is about 500ft., and from the road which runs along the crest the view extends to the blue hills of Charnwood, fifteen miles away, and westward—across the coal-field—to the bossy mass of Dost Hill. Examining the very base of the Hartshill Range, rocks of Pre-Cambrian age can be detected near the windmill at Caldecote. Here, in a little spinney between the mill and a large house, there is an old disused quarry in which a good section is exposed. The bulk of the rock is a dark basaltic-looking mass—possibly a diabase—which breaks across a very interesting rock—a quartz-felsite*—of which only a small portion is visible at the northern end of the quarry. This quartz-felsite much resembles similar rocks which occur in the Pre-Cambrian formation near Llanberis in North Wales. Below these rocks, in a kind of tunnel leading towards the house, we find volcanic grits and ashes comparable with those which are so common in Charnwood Forest. Altogether the Pre-Cambrians here form a narrow strip rather more than a mile in length, bounded to the east by a fault whose throw must be very great, since it brings the Keuper marls to a level with the Archæan strata.

The Quartzite of Hartshill.—Resting upon the volcanic rocks just described we find a considerable thickness of a metamorphosed sedimentary rock—a quartzite (once a sandstone) about 1,000 feet in thickness. Its base is a breccia, composed of small pebbles of the underlying rocks, but higher up it becomes exceedingly hard and compact. In the upper portion narrow bands of shale appear, which increase in number and thickness towards the top. The strike of the quartzite strictly accords with the direction of the ridge which is composed of it, being from north-west to south-east (parallel to the Charnwood axis), while the dip is to the south-west at an average angle of 35 degrees. The rock is extensively worked for road-metal, and is exposed in the quarries in a series of magnificent sections, all the way from Nuneaton to Hartshill. Its colour varies from white to red; although fossils have been diligently searched for, not a trace of one has as yet been discovered. Two dykes of diorite traverse the quartzite nearly parallel to its strike. One is well seen on either side of the Midland Station at Nuneaton; the other, which is much thinner, is exposed in the quarries close to Hartshill. The geological age of the quartzite is a

* Mr. T. H. Waller has kindly promised to examine these rocks microscopically, and to report upon them in an early number of the *Midland Naturalist*.

difficult question, and its consideration will be better deferred till the mode of occurrence of the same rock in other localities has been described.

The Stockingford Shales.—Resting upon the quartzite, and forming a region of rugged ground which lies to the west of the Hartshill range, we find a considerable thickness—nearly 2,000 feet—of rubbly shales or mud-stones, which may be called the Stockingford Shales, because they are well exposed in the railway cutting of the Midland line between Stockingford and Nuneaton. At the base—where they rest upon the quartzite—these Cambrian shales vary from red to purple in colour, but higher up they are more commonly grey or black. Nodules of manganese—formerly worked in several little pits—occur in the red shales. The general dip of these beds is to the south-west, at angles of from thirty to as much as seventy degrees. Lying parallel to the quartzite, the shales occupy a much larger area, extending from beyond Atherstone in the north to Marston Jabet in the south, a distance of more than ten miles; while they occupy a surface-strip whose breadth varies from half a mile to rather more than a mile. At each extremity of this strip the beds roll over and assume an easterly dip, which is well seen in the old quarry near the Hall at Marston Jabet; and which is also indicated by the corresponding anticlinal of the coal measures north of Atherstone. Thus the structure of the country is that of an anticlinal, broken through by a great fault about the centre (near Hartshill), but preserving its crest to the north and south of this point of maximum dislocation. The shales are traversed by several dykes or intrusive sheets of diorite (well described by Mr. S. Allport *) which run more or less parallel to the strike of the shales. Here and there the dioritic rock thickens out into a boss, such as the great mass which is quarried near Oldbury Hall. Further south a fine section showing four dykes, traversing and sending out tongues into the shales, can be seen in the railway cutting at Chilvers Coton.

Owing to the difference in hardness between the diorites and the shales, steep ravines have been eroded in the latter; these form a striking feature in the scenery round Hartshill.

In the Stockingford cutting red shales are seen at the Nuneaton end, and these are overlaid by purple, grey, and black shales which undulate considerably, but whose average dip is at a high angle to the west. The only fossil I obtained here was an *Obolella*. At Camp Hill the red basement shales are

* Quarterly Journal Geological Society, Vol. XXXV., p. 637.

exposed, and there are numerous other exposures along the general line of outcrop, all of which have the same character. Where the diorite crosses the sedimentary rocks the latter are much altered, being baked, bleached, and shattered. Fossils of certain genera are fairly numerous, although imperfect; but the species are few. They include the trilobite *Agnostus* (probably *A. pisiformis*), and a small *Lingulella* which is very like *L. ferruginea*. Professor Lapworth has also identified *Lingulella Nicholsoni*, *Obolella Salteri*, *Kutorgina cingulata*, and *Acrotreta socialis*. These are undoubtedly Cambrian species, but they are hardly sufficient to enable us to refer the Stockingford shales to a precise horizon in the Cambrian formation. Taking all points into consideration, however, we may, perhaps, assign these shaly beds to the period of the Upper Lingula Flags and Tremadoc Slates, in which the same general assemblage of fossils occurs. The Stockingford shales are separated from the coal-measures by a considerable fault which runs curving along the strike. It is marked by a line of brick pits, in which the rubbed-up material or "fault-stuff" is worked, and its effects are well seen in the deep pit in coal-measure binds and sandstones about a quarter-mile east of Stockingford station. All the diorite dykes end abruptly along this line of fault, showing that the period of their intrusion into the Cambrian shales was Pre-Carboniferous.

4.—*The Cambrian Rocks of Dosthill.*—The western boundary of the Warwickshire coal-field is, like the eastern, marked by the appearance of Cambrian rocks which have been brought to the level of beds of much more recent geological age, by the agency of faults running parallel to the strike of the strata.

Dosthill is a low eminence, four miles south of Tamworth, and not far from the Kingsbury Station of the Birmingham and Derby Railway. It owes its present elevation to igneous rocks of two or three varieties—mainly diorite—which traverse Cambrian shales. On the west of the hill, which rises precipitously from the course of the River Tame, a line of fault runs, by which the Triassic strata are placed on a level with the Cambrian shales, while on the eastern side a parallel fault of less "throw" places the coal-measures in a similar position; the latter rocks are well exposed along the railway, and a line of collieries marks the outcrop of the coal-seams, which in some cases are worked from their outcrop almost vertically, so greatly have they been bent up by the elevating action to which the central slice of Cambrian strata — sandwiched between Carboniferous and Trias—owes its position.

The Dosthill Shales are remarkable for the abundance of worm-tracks which they contain. In a small field-pit, quite close to the main road, at the southern extremity of the hill, there is a good exposure of these "annelidean" shales, through which a neck or pipe of igneous rock is seen to rise, spreading out above into a horizontal sheet. Altogether the Cambrians of Dosthill occupy but a small area—less than a square mile. I have not detected the quartzite *in situ* here, but it is probably at no great depth, as large loose blocks lie upon the surface, brought up, it may be, along the line of fault.

It would thus appear that the floor of the Warwickshire coal-field is composed of Cambrian rocks, the Silurian and Devonian strata being absent. This is confirmed by the Leicestershire borings to which we shall presently allude.

A note as to the discovery of the true age of the Pre-Carboniferous rocks of Warwickshire may not be out of place here. In February, 1882, I read a paper* before the Philosophical Society of Birmingham, in which it was insisted that the hard rocks that occur as pebbles in the Permian, Bunter, and Keuper strata of the Midlands were derived—not from Wales and Scotland as Professors Ramsay and Hull had asserted—but from old rocks which formerly stretched more or less continuously right across Central England, and of which patches stili existed at the surface. This paper, and the discussion which followed it, led to the announcement a few weeks later by Mr. F. T. S. Houghton and Professor Lapworth of the distinction between the Llandovery sandstone and the Cambrian quartzite of the Lickey Hills. By this time I had myself examined the Lickey Hills and I was at once struck with the resemblance between the true quartzite, which forms the greater part of the ridge, and specimens of the Hartshill quartzite which my students had brought to me when I was curator of the Leicester Museum. This Hartshill rock had been mapped as "altered Millstone Grit," by the officers of the Geological Survey.

I found that my doubts as to the correctness of the Survey classification were shared by Professor Lapworth, and in May, 1882, we paid our first visit to Nuneaton. A glance at the quartzite there was almost sufficient to prove its identity with that of the Lickey, so exact was the petrological agreement. Within the next few days we found the Pre-Cambrians below the quartzite at Caldicote, and the fossiliferous Cambrian shales both at Stockingford and Dosthill.

(To be continued.)

* On the Quartzite Pebbles contained in the Drift, and in the Triassic strata of England, and on their derivation from an ancient Land Barrier in Central England. Proc. Phil. Soc., Vol. III., p. 157.

LIFE HISTORY OF A FILIFORM ALGA (*ŒDOGONIUM*).*

BY M. C. COOKE, M.A., A.L.S.

The subject selected for a short communication this evening is a somewhat commonplace one, and also one on which I do not pretend to have anything novel or sensational to say. All that I have set myself to do is to go over the history of a single species of Filamentous Algæ such as is found in our ponds and ditches.

At first I proposed to myself to give a general summary of Fresh-water Algæ, but being convinced by experience that generalisation is a most unsatisfactory process both to speaker and hearers, I resolved to limit my illustrations as much as possible to one species, leaving that to stand as a type of the Thread-like Algæ; merely reminding you that other species and other genera, or families, will differ more or less, in different directions, even as one family of flowering plants differs from another.

The object which I have in view may be briefly stated at the outset, and thus we shall come to understand each other, and perhaps avoid disappointment at the close. That object is simply to call your serious attention to those little-known aquatic plants which we call Fresh-water Algæ, and, if possible, give you a sufficient interest in them to stimulate enquiry and, it may be, awaken a desire to learn something more. There is a notion which some people possess, that everything outside their own particular circle of knowledge is unworthy of their attention. This is at best a foolish notion, and I may take it for granted that your presence here to-night exonerates you from any participation in it. If I should err in treating the subject in too elementary a manner, I beg that you will not imagine that I deem it necessary for your sakes to follow such a course, but that I am trusting to your indulgence, for the sake of those outsiders who may read my remarks, in the hope of obtaining some information.

I was out one early day in the summer on an excursion near the confines of Epping Forest, together with some kindred spirits, hunting in ponds and pools for living objects to furnish material for work with the microscope. There are still numerous small pools or ponds left in that neighbourhood,

* Transactions of the Birmingham Natural History and Microscopical Society. Read October 21st, 1884.

although the hand of man is ever doing its best to improve them off the face of the earth. Instead of leaving us Nature unadorned, as we love to see her, public corporations always want to do too much, and convert our Epping Forests or Sutton Parks into ornamental tea gardens.

Some dead rushes were bent down near the edge of the pool, and totally immersed in the water. The naked eye was quite sufficient to discern that these rushes were covered with slender delicate filaments which floated out for half an inch into the surrounding water, almost of the colour of whitey-brown paper. Several of the most promising rushes were drawn out of the water, cut into short lengths, and placed in a glass tube, carefully corked, and transferred to the pocket. It matters not what else was collected during the day, since it is only of these delicate floating filaments found attached to the dead rushes that I desire to speak. It may be taken for granted that they were the filaments of a filamentous, or thread-like Water Alga, growing attached to dead plants. All that we would learn of them beyond this must be discovered by the use of the microscope.

I will not detain you with any details of manipulation; suffice it to say that a little of this floating mass, taken off on the point of a sharp penknife, was placed in a drop of water, and submitted to inspection under a quarter of an inch objective. The first glance was sufficient to show that it was a species of the genus *Œdogonium*. But why? I will endeavour to explain.

In the first place all the threads are discovered to be simple, without branches of any kind from the base to the apex, and these threads parted off by transverse partitions or septa at regular distances throughout their entire length. We will call these joints, or the intermediate space between any two of the partitions, a cell. These threads are made up, then, of a series of elongated cylindrical cells, attached end to end, so as to form a filament, it may be half an inch in length. Each of these cells contains within it a granular matter, at one time wholly green, but now partially discoloured, which we will call the cell contents. Looking again carefully at the membrane which constitutes the wall or boundary of these cells, we soon observe that some of the cells have delicate parallel lines or striæ crossing them near the top, and some of the cells have none. Whatever these lines may be, and we shall endeavour to discover their meaning presently, it is due to their presence that we have been able to affirm at once that this Alga is a species of *Œdogonium*.

In many genera of Confervoid Algæ, and indeed in most, vegetation goes on at the apex, so that the basal cells are the oldest, and the terminal cells the youngest; the thread being increased in length by continued growth and subdivision of the terminal cell, but in *Œdogonium* this is not the case, since the intermediate cells possess the power of dividing and increasing by interposing a new cell, hence old and new cells will alternate. When a cell has reached maturity, and is about to divide, a little circular line is seen near its upper end. Gradually this line widens, and then it is seen that the wall of the mother cell has divided all round, and the cell above it is being slowly raised by the growth of a new cell, a daughter cell, arising, as it were, out of the apex of the mother cell, and carrying upwards the first streak, or cap, which was left by the breaking away of the wall of the mother cell. In this manner the new cell soon attains a length equal to that of the mother cell from whence it sprung. This accounts for the single line, which crosses just below the apex of some of the cells. When this young cell is matured it becomes in turn a mother cell, the splitting round is repeated, a second streak or line is formed just below the first, indicating that a second cap is being carried upwards, and so on until as many as four, five, or six striæ or caps are formed, which indicate that four, five, or six cells have been successively formed, the last one carrying up on its apex, one within the other, all the caps left by the circumscissile division of each successive cell, the number of caps or striæ corresponding to the number of cells produced consecutively immediately beneath the caps. By careful observation it will be seen that the youngest cells are narrower than the parent cells by the thickness of the cell wall.

Thus much, then, for the vegetative growth of the filament which accounts for the striæ at the apices of many of the cells.

(To be continued.)

DR. J. GWYN JEFFREYS.

On the 24th of January last there passed away, after a long and active life, the veteran conchologist, Dr. J. Gwyn Jeffreys. He belonged to a school of bygone scientists, whose honoured names live in the remembrance of the present generation by their works—beautiful alike in matter and production—and of daily reference by the student and worker. Retiring from the Bar about 1857, he was enabled to follow up his favourite pursuit of science, which he did with unflagging vigour until the day before he was seized with the illness which terminated his active and honourable career.

It would be a task outside the scope of this short notice—dictated, as it is, by a feeling of regard for the late Doctor—to enumerate the many valuable essays and papers published by him; they are known to most students of conchology; his largest and most popular work, "British Conchology," in five volumes, is the standard work of our time on the subject.

Dr. Gwyn Jeffreys was a great dredger. From 1861 to 1868 he explored the Northern seas in the "Osprey," his own boat; between-times visiting the Channel Isles, S. W. Ireland, &c. In 1869, in the "Porcupine," under the auspices of the British Government, and in charge of the expedition, he explored the West coast of Ireland; in 1870, the great depths of the Southern coasts of Europe were explored; in 1876, in the "Valorous" (going out with the Arctic Expedition as far as Baffin's Bay), he dredged in Davis' Strait and the North Atlantic; in 1880, by invitation of the French Government, he was with the Gallic savants dredging the depths of the Bay of Biscay; in 1878-9, he accompanied the well-known naturalist, the Rev. Merle Norman (often before a fellow-worker) to Norway, for dredging the fiords. He was well known to every *locum tenens* dignified by the name "naturalist" of the best collecting grounds on our own coast. "Why, bless your life, sir," said one of these worthies to us years ago, "I've took Forbes and Jeffreys and Thomson and lots o' them gentlemen, many's the time, out for days an' days together." What further passport to oracular belief need he advance!

Had the lamented Doctor been spared "yet a little while" he would have added still further to our knowledge, as some of his intended work remains awaiting the "touch of a vanished hand." An excellent trait in him was his kind and ever ready help to all who sought it in the elucidation of problems or the identification of species, as will be testified by a large circle of amateurs. The writer is rich in many letters from him. He was always punctual in reply, never sparing himself, but giving the benefit of his large and varied experience ungrudgingly.

It is a matter of regret to us that his great and valuable collection of typical and representative forms has gone to America. Worthy and noble supporter of science, ungrudging and liberal in its cause, an example to nations—we only regret our loss; we do not envy you your gain.

Dr. Gwyn Jeffreys took an active part in the work of the British Association, supporting the resolutions recommending its last, and coming, meetings in Birmingham.

Dying at the ripe age of seventy-six—what a revolution has taken place since, at the early age of nineteen, he contributed his "Synopsis of the Pneumonobranchous Mollusca of Great Britain" to the pages of the Linnean Transactions. With many other of the older naturalists he did not take kindly to the new doctrine, whose trumpet blast "shook the walls of the ancient Jericho," though, if he did not all accept it, he never actively opposed it. We do not carp; those who make the bricks build, and the temple of knowledge has been raised by many and varied hands. The builders have happily "wrought with anxious care," according to the "light which was in them."

G. S. T.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 54.)

GRAMINA *(continued)*.

ARRHENATHERUM.

A. avenaceum, *Beauv.* *False Oat Grass.*

Native: On banks, roadsides, and in cultivated ground and pastures. Common. June to August. Area general.

b. nodosum. Rare or overlooked.

II. Occasionally in marly land about Warwick, *H. B.* I have never seen this variety anywhere in the county.

HOLCUS.

H. mollis, *Linn.* *Creeping Soft Grass.*
Native: On banks, roadsides, and damp shady woods. Locally common. July, August. Area general.

H. lanatus, *Linn.* *Meadow Soft Grass.* *Yorkshire Fog.*
Native: In pastures, meadows, on banks, roadsides, and heathy lands. Very common. June to September. Area general.

TRIODIA.

T. decumbens, *Beauv.* *Decumbent Heath Grass.*

Native: On heaths, heathy roadsides, and sandy meadows. Local. June, July.

I. Sutton Park; Middleton Heath; Coleshill Heath, over a wide area; Marston Green; meadows near Ansley Hall; meadows near Berkswell Hall; roadsides near Balsall Street; Forshaw Heath.

II. *(Poa decumbens.)* Footway from Alcester to Wetherly, *Purt.*, i., 81. Beausale Common; Haywoods! *Y. and B.* Kenilworth Heath! Honily, *H. B.* Tachbrook Pastures; near Umberslade Hall; near Wilmcote; Austey Wood, Wootton Wawen; Stoke Heath, near Coventry.

KOELERIA.

K. cristata, *Pers.* *Crested Hair Grass.*

Native: In old pastures and on grassy roadsides, in marly and calcareous soils. Very local. June, July.

I. Footbridge, Bradnock's Marsh. June, 1882.

II. Tachbrook! *Y. and B.* Pastures near Ashorn! *H. B.* Honington; Tredington, *Newb.* Marly field, near Oversley Wood; bridle road from Billesley to Wilmcote; Bardon Hill; pastures and roadsides near Chesterton Wood; roadsides near Prince Thorpe.

MOLINIA.

M. cœrulea, *Moench.* *Purple Hair Grass.*

Native: In bogs and damp woods and on moist heath lands. Local. August.

I. (Melica cœrulea) Coleshill Bog! Purt., i., 75; Sutton Park; Trickley Coppice, Middleton; Bentley Park; Coleshill Heath; Arley Wood; Marston Green; Bradnock's Marsh; Olton Reservoir; Bentley Heath, near Solihull; Forshaw Heath, near Tanworth; Windmill Naps, near Little Ladbrook.

II. Rounshill Lane! *Y. and B.;* Frankton Wood, *R.S.R.*, 1878; Alveston Pastures; All Oaks Wood, Cathiron Lane.

MELICA.

M. uniflora, *Linn.* *Wood Melic Grass.*

Native: In woods and shady lanes in marly soils. Locally abundant. May, June.

I. Pool Hollies Wood, Sutton Park; lanes about Oldbury and Hartshill; Edge Hill and Kingsbury Woods; lanes near Arley; Shustoke; Maxtoke; Coleshill: Kenwalsey; Fillongley; Corley Moor; Holly-Berry End; Marston Green; Berkswell; Frogmore Wood, Fen End; Solihull; Packwood.

II. Oversley Lane! *Purt.*, i., 75; Yarningal! *Y. and B.;* Allesley! Coventry; *Bolton King;* Little Alne; Shelfield Green; Moreton Bagot; lane near Bush Wood, Lapworth; Green Hill Green, near Spernall; Out Hill, near Studley; Baddesley Clinton; Brandon.

CATABROSA.

C. aquatica, *Beauv.* *Water Whorl Grass.*

Native: On the margins of pools, ponds, and canals. Rather rare.

I. (*Aira aquatica.*) Edgbaston Pool, *With.*, ed. 4, 138; Sutton Park; near Polesworth; Tamworth; canals near Atherstone and Mancetter; Hartshill; small pool near Solihull Railway Station; near Brown's Wood, Sharman's Cross; Bradnock's Marsh.

II. (*Aira aquatica.*) Bidford, *Purt.*, i., 74; brook in Baly's Lammas, Warwick, *Perry Fl.*, 8; Kenilworth, *Y. and B.*; pond near Bilton, *R.S.R.*, 1867; old canal near Harborough Magna! *L. Cumming*; pond near Farnborough; canal near Wilmcote; canal, Sowe Waste and Ansty; canal, Longford; canal near Preston Bagot, abundant; Pool Green Hill Green, near Spernal.

GLYCERIA.

G. fluitans, *Brown.* *Floating Meadow Grass.*

Native: In pools, ponds, ditches, streams, and canals. Common. June to August. Area general.

b. pedicellata, Towns.

I. Ditches near Plant's Brook; small pond near Bradnock's Marsh.

II. Honington! *F. Townsend*; Tredington, *Newb.*; Rounshill Lane! *H. B.*; canal, Rowington; canal near Preston Bagot; canal, Tardebigge; canal, Sowe Waste; near Stoke.

G. plicata, *Fries.* *Folded-leaved Meadow Grass.*

Native: Near pools, ponds, ditches, and canals. Local, but widely spread. June to August.

I. Small pond near Bradnock's Marsh; pool near Chesset's Green; Monkspath.

II. Myton! *H.B.;* Rowington; Kingswood; canal near Tardebigge; wayside drain, Brinklow; canal, Sowe Waste; pool near Ansty.

Var. *subspicata.*

II. Fern Hill, *H.B.;* canal near Tardebigge.

G. aquatica, *Sm.* *Water Meadow Grass.*

Native: In rivers, pools, and canals. Locally common. August, September.

I. Near Sutton; Plant's Brook; canal near Atherstone; river Anker, Tamworth; in the Blythe, near Packington; near Blythe Hall, Coleshill; Dukesbridge; River Blythe, near Stonebridge; Blythe Bridge, near Solihull; Olton Reservoir; canal, near Three Maypoles, Shirley Heath.

II. Honington, *Newb.;* Kineton, *Bolton King;* frequent in the Rivers Avon, Alne, and Arrow; canal, Rowington; Oversley; Bidford; canal, Longford; Sowe Waste and Ansty; near Birdingbury Wharf; near Long Itchington Wharf.

SCLEROCHLOA.

S. rigida, *Link (Poa.* Purt). *Hard Meadow Grass.*

Native: On wall tops, roofs, and sandy places. Rather rare. May to July.

II. Wall at Oversley Green Bridge, *Purt.*, i., 80; a very robust form is abundant at the foot of the bridge near Oversley, but not on the walls about there, 1880; Ufton, *Y. and B.;* walls, Fenny Compton; walls at Abbott's Salford; Binton Church; Temple Grafton; Exhall and near Stratford-on-Avon; old walls on the Edge Hills; in marly fields near the Golden Cross, Exhall; marly roadsides and banks, near Prince Thorpe.

POA.

P. annua, *Linn.* *Annual Meadow Grass.*

Native on roadsides, walls, and heath lands, pastures, &c. Flowers all the season, and is common throughout the county.

P. nemoralis, *Linn.* *Wood Meadow Grass.*

Native: In woods, copses, and on marly banks and wall tops. Locally abundant. June, July.

I. Plentiful in lanes between Shustoke and Arley; lanes about Maxstoke; fordrough in the lane from Water Orton to Minworth; near Sheldon Church; lane from Stonebridge to Meriden Marsh; near Bradnock's Marsh; Cornel's End; Henfield, near Knowle; Frogmore Wood, Fen End.

II. Bushy bank between Alcester and Arrow, *Purt.*, iii., 9; Woodloes; Milverton, *Y. and B.;* Ragley Wood; marly banks near Oversley Wood; lane near Wootton Wawen; between Berkswell and Tile Hill; lanes about Wyken, Ansty, Sowe and Stoke.

b. angustifolia. More rare.

I. Coppice near Minworth.

II. Wall tops, Oversley Village; Oversley Wood; Ragley Wood.

P. compressa, *Linn.* *Flat-stemmed Meadow Grass.*

Native: On old walls, banks, ruins, and in cultivated land. Local. July.

I. Maxtoke Priory ruins; old walls near Fillongley Hall; banks near Oldbury Hall; cornfields near Cornels End; lane near Meriden Shafts; Waste Lane, Berkswell; old walls near Balsall Heath.

II. Chesterton! Tachbrook, *Y. and B.;* house tops about Harborough-Magna, *Rev. A. Blox;* on walls, Marl Cliff; Bidford; Oversley; Wilmcote; Bearley; in fields, Spernal Ash, and Great Alne; wall, Red Hill, near Alcester; on walls near Stratford-on-Avon; quarry near Little Lawford; pastures, Newbold-on-Avon.

b. polynoda, Parn.

II. Brick Hill Lane, Coventry, *T. K., Herb. Brit. Mus.;* railway cutting near Henley-in-Arden; old walls, Wootton Wawen; Binton; old walls, Shottery; Tredington Village.

P. pratensis, *Linn.* *Smooth Meadow Grass..*

Native: In fields, pastures, on banks, wall tops, &c. Very common. May, June. Area general.

Var. *b. angustifolia,* Gaud. Rare.

II. Marly banks near Prince Thorpe; banks near Moreton Bagot.

Var. *c. subcærulea,* Sm.

On heaths, heathy roadsides, and wall tops, more or less frequent throughout the county.

Var. *d. strigosa,* Gaud. Rare or overlooked.

II. On old walls near Bidford.

P. trivialis, *Linn.* *Rough Meadow Grass.*

Native: In woods, shady places, on banks, and in meadows, &c. Common. June, July. Area general.

Var.. *b. Köhleri,* DC. Very rare or overlooked.

II. Oversley Wood.

A very singular and marked variety of *P. trivialis*, having smaller flowers and more compact panicles than the type. A marked form of *P. trivialis* also occurs in sandy fields near Wilmcote; this I have not yet been able to assign to its proper place.

[*P. sudetica,* Haenke, is abundant and well established in a coppice near Leek Wootton (see Exchange Club Report, 1876), but is not more than an alien or casual weed.]

BRIZA.

B. media, *Linn.* *Common Quaking Grass.*

Native: In pastures, by roadsides, and rarely on damp heath lands. Rather local. July.

I. Sutton Park, on damp heath lands; roadsides near Penns; Birchley Heath; Water Orton; near Knowle and Solihull, &c.

II. Chesterton! *Y. and B.;* near Henley-in-Arden; near Stratford-on-Avon; near Binton Bridges; Bardon Hill; Newbold-on-Avon.

CYNOSURUS.

C. cristatus, *Linn.* *Crested Dog's-tail Grass.*

Native: In meadows, pastures, by roadsides, &c. Very common. June, July. Area general.

Occasionally I have found it with proliferous spikes.

DACTYLIS.

D. glomerata, *Linn.* *Rough Cock's-foot Grass.*

Native: In meadows, pastures, and on roadsides and banks. Very common. June to September. Area general.

FESTUCA.

F. Pseudo-myurus, *Soyer.* *Mouse-tail Fescue Grass.*

Native: On wall tops and sandy roadsides. Rather rare. June, July.

I. Slade Lane, Witton, on sandy roadsides; on banks near Erdington.

II. Emscote, *H.B., Herb. Brit. Mus.;* Warwick, old walls! *Herb. Perry;* Milverton, *Y. and B.*

F. sciuroides, *Roth.* *Barren Fescue Grass.*

Native: In pastures, on grassy roadsides, and on walls. Locally common. May, June.

I. Sutton Park; Middleton Heath; Coleshill Heath; lanes near Hampton-in-Arden; Solihull, &c.

II. *(Festuca bromoides)* King's Coughton; Coughton Court! *Purt.*, i., 83; Kenilworth, *Y. and B.;* Honington, *Newb.;* near Oversley; in hilly pastures near Great Alne.

F. ovina, *Linn.* *Sheep's Fescue Grass.*

Native: On heaths, heathy roadsides, and woods. Locally abundant. June, July.

I. Sutton Park, on the common land near Four Oaks; Middleton Heath; Baddesley Common; Bannersley, near Coleshill; Coleshill Heath: Bentley Heath, &c.

II. Milverton, *Y. and B.;* Armscote, *Newb.*

b. tenuifolia, Sibth. Local and rare.

I. Hilly pastures near Gravelly Hill Station; very abundant on heaths and in woods at Sutton Park; near Middleton Hall; Middleton Heath; Spinney, near Bannersley Rough; Baddesley Common; Marston Green; Earl's Wood; Balsall Common; Forshaw Heath.

II. Armscote, *Newb.*

F. rubra, *Linn.* *Linn. Sm.* *Hard Fescue Grass.*

Native: In damp pastures, and on sandy banks and roadsides. Very common. June, July. Area general.

A very variable grass both as to its habit of growth and colour, many of the forms being so distinct as to be at once recognised, and the varieties require, I think, more careful investigation than I have been able to bestow upon them.

Var. *fallax*. Rare.

I. Earlswood Reservoir, 1883; canal siding near Hockley.

This was named for me by Prof. Haekel, of St. Poelton, and will, I think, be found more common than now appears when better known.

Var. *longi-aristata*, Haekel, *M.S.*

This was sent to Prof. Haekel in 1882 and was considered by him to be new as a variety; it grew fairly abundant near Combe Abbey in 1880, but I could not find it again this year, so that it may be, as since suggested by Prof. Haekel, an accidental form. It is noticeable for the very long awn, longer even than the flowering glumes.

F. elatior, *Linn. Tall Fescue Grass.*

Native: On roadsides and near canals in marly soils. Local and rare. June, July.

I. Near Witton Reservoir; near Olton Pool; rare in the Tame basin.

II. Itchington Holt! *Y. and B.;* Honington; Tredington; Shipston, *Newb.;* Little Lawford, *H. W. T.;* Marl Cliff; Binton, Redhill; roadsides between Redhill and Stratford-on-Avon; canal banks near Wilmcote and near Rowington; Cathiron Lane and canal siding near Brinklow.

Two forms occur in the county, one of them being very near the variety *b. arundinacea*, but scarcely agreeing with the maritime forms of that variety.

F. pratensis, *Huds. Meadow Fescue Grass.*

Native: In meadows, damp pastures, and on roadsides. Common. June, July. Area general.

b. loliacea, Huds. Rare.

I. Roadsides near Moor Hall, near Sutton; near Oldbury Hall; damp meadows Blythe Bridge, near Solihull.

II. Shut Lane, Coventry, T.K., *Herb. Perry;* Myton, *Y. and B.*

F. gigantea, *Vill. Tall Fescue Grass.*

Native: In woods, copses, and on shady banks. Locally common. July to September.

I. Middleton Woods; Heathland, near Tamworth; Hartshill Hayes; Bentley Park; near Arley Railway Station; Dukesbridge, near Coleshill; lane to Hams Hall from Curdworth Bridge; Olton Pool; Shelly Lane, near Solihull; wood near Berkswell Hall; woods near Earlswood.

II. Wixford Lane, *Purt.*, i., 77; Tachbrook, *Y. and B.;* Honington; Tredington; Shipston-on-Stour, *Newb.;* Alveston Pastures Wood; Oversley Wood; Bearley and Snitterfield Pastures; Stooper's Wood, near Wootton Wawen; in several of the lanes from Lapworth Street to Kingswood; coppice in Quarry Lane, Wroxall; Oakley Wood; Cubbington Wood; Stoneleigh; Combe Woods.

b. triflora, Linn. Rare.

II. On marly banks in a lane from Great Alne to Alne Hills, abundant there. A mere form.

(To be continued.)

METEOROLOGICAL NOTES.—JANUARY, 1885.

The barometer was high at the commencement of the month (30·392 inches), but fell slightly till the 5th, rising again to the 7th, after which it fell rapidly till the 11th (28·773 inches), and again rose till the 19th, falling again gradually till the end of the month. The weather was, for the most part, overcast and dull, with rarely a bright day. The temperature was variable, but at no period of the month very cold. The mean was, however, nearly 2 degrees below the average, and 7 degrees lower than that of January, 1884, but this is attributable to the low maxima, which were under 40 degrees on 16 days. The highest readings generally were on the 29th, and were as follows:—53·8° at Hodsock, 53·7° at Loughborough, 52·0° at Coston Rectory and Henley-in-Arden, and 50·8° at Strelley. 85·1° was registered in the rays of the sun at Loughborough on the 27th, and 76·4° at Hodsock on the 14th. The minimum readings were 18·6° at Hodsock on the 22nd, 19·0° at Coston Rectory on the 6th, 20·9° at Strelley on the 22nd and 23rd, 21·0° at Henley-in-Arden, and 21·4° at Loughborough on the 22nd. On the grass 15·0° was registered at Hodsock, and 15·7° at Loughborough on the 22nd; and 16·5° at Strelley on the 6th. The rainfall was decidedly below the average, and was confined to two periods—at the middle and end of the month. The total values were 2·03 inches at Strelley, 2·08 inches at Henley-in-Arden, 1·61 inches at Coston and Loughborough, and 1·42 inches at Hodsock. The heaviest fall generally was on the 10th, and the number of "rainy" days varied from 18 to 23. Snow, in small quantities, fell on the 12th, 13th, 14th, and 17th. Sunshine was very deficient. Lunar halos were seen at Loughborough on the 25th and 27th. Lightning was observed at Coston Rectory on the 10th. WM. BERRIDGE, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

MM. FREMY AND URBAIN on the 5th of January brought before the Académie des Sciences their "Chemical Study of the Skeleton of Plants." They drew attention to cutose, the substance which covers and protects the aërial organs of plants, and is shown to approach the fatty bodies in its properties and composition. Cutose resists the action of energetic acids, it is insoluble in dilute alkalies, neutral solvents have no action upon it, but boiling alkaline liquids modify its conditions. This paper opens out a new field of enquiry.

ABNORMAL INFLORESCENCE OF THE HAZEL.—My friend Mr. Frederick Enock, of Woking, has recently sent me a very interesting example of what appears to be a "multiplication of axile organs" in the case of an abnormal state of the male inflorescence of the Hazel, *Corylus Avellana*. In this instance the branch is terminated by a truly cone-like head of catkins, about seventy in number. The catkins are immature, and their arrangement is quite symmetrical. An illustration of a somewhat similar instance is given in Dr. Masters' valuable "Vegetable Teratology," page 349, which will give a fair idea of this abnormality, except that the arrangement of the catkins in Mr. Enock's specimen is more regular. This abnormal condition is possibly due to an over-development of male buds, with an abnormal suppression of the internodes; the bracts are absent in this case. I have never before seen a like case, and think it must be a rare phenomenon.—J. E. BAGNALL.

MR. JOSEPH PRESTWICH, Professor of Geology in the University of Oxford, has, by thirty-two votes out of fifty, been elected a corresponding member in mineralogy of the Académie des Sciences in the place of the late Quintino Sella.

M. A. BECHAMP brought before the Académie des Sciences, on January 19th, a paper "On the Origin of the Microzymas and Vibrionians Everywhere." He argues against M. Pasteur that these germs are to be sought for originally in the ground and water, where they are deposited by the disintegration of the neozoic and palæozoic rocks and by decomposing animal and vegetable matter of all kinds.

MR. FERGUSON, of Kinmundy, read a paper before the Edinburgh Geological Society at the last meeting "On Certain Deposits of Graphite and Iron in Aberdeenshire." Details were given of veins of hæmatite iron and manganese which are very extensive, and many of the veins were found to be as rich as the Spanish ore. Plumbago is plentiful, the only question being its production and transport so as to be used economically.

NOTES FROM WOKING.—On April 13th, 1883, as recorded in the "Midland Naturalist," I found a large colony of the British Trap-door Spider, *Atypus piceus* (Sulzer), in this neighbourhood. Since that time I have found three other colonies, to all of which I have made very frequent tours of inspection, carefully noting down on the spot something relating to the habits and economy of this most interesting spider, whose life-history I shall be able to give in a few months hence. On December 30th, 1884, whilst examining one of the "tubes" or nests, I displaced some of the loose sand, causing it to fall down, when out crawled an Andrena, which, after shaking itself clean, tried to fly, but was quickly boxed, and before I had time to transfer it to my pocket, I saw a Nomada extricate itself from the loose sand, and it succeeded in flying a few inches before I captured it. The day had been beautifully fine and spring-like, though the night following was frosty. I transferred both bees to a large pot nearly full of sand, and, on examining next day, found both had buried themselves, the Nomada coming up again in a few days, remaining on the moss, except when the weather was warmer, when it became very active. I took it out on January 21st, and next day dug the Andrena out, which had burrowed down four inches deep. I sent both specimens to Mr. Ed. Saunders, who always is so kind in giving me the names of bees, &c. He identified them as male *Andrena nigroænea* and female *Nomada alternata*. No doubt the exceedingly mild November had brought them forward more than three months before the usual time of their appearance.—FRED. ENOCK.

LYCOPODIUM CLAVATUM.—Mr. Enock has also sent me specimens of the Wolf's Claw, *Lycopodium clavatum*, from heath lands, near London, and the sight of this interesting plant recalled to my recollection the fact that it was first recorded as a British plant from Hampstead Heath by Gerarde in his "History of Plants," 1597. Some of the readers of this magazine may feel an interest in knowing what our old and quaint friend Gerarde had to say about this plant, for it is sometimes pleasant to hear what our predecessors of 300 years ago thought and said about objects which interest some of us who live in more enlightened times. Speaking of this plant, which he calls *Muscus clavatus, sive Lycopodium*, Club Mosse, or Wolfe Claw Mosse, he says, "There is likewise another sort of mosse, which I have not elsewhere found than upon Hampstead Heath, near unto a little cottage, growing close upon the ground amongst bushes and brakes, which I have shewed unto divers surgeons of London, that have walked thither with me for their further knowledge in simples, who have gathered this kinde of mosse, whereof some have made them hat-bands, girdles, and also bands to tye such things as they had before gathered, for which purpose it most fitly served; some pieces whereof are six or eight feet long, consisting, as it were, of many hairie leaves set upon a tough string, very close couched and compact together, from which is also sent certain other branches like the first; in sundry places there be sent down fine little strings, which serve instead of roots, wherewith it is fastened to the upper part of the earth and taketh hold likewise upon such things as grow next unto it. There spring also from the branches bare and naked stalks, on which grow certaine ears as it were like the Katkins or blowings of the Hasell Tree; in shape, like a little club or the reede Mace, saving that it is much lesser, and of a yellowish white colour, very well resembling the claw of a wolfe, whereof it tooke his name; which knobby katkins are altogether barren bringing forthe neither seed nor floure." He also informs us, that "Being stamped and boyled in wine and applied, it mitigateth the paine of the gout. Floting wine, which is become slimie, is restored to his former goodness, if it be hanged in the vessel." Ger. Em., pp. 1562-4. The catkins which he mentions are the male flowers of the plant, and produce a great quantity of spores, the existence of which appears to have been unknown to him. Johnson, "Useful Plants of Great Britain," states that "The spores are collected in considerable quantities for the manufacture of fireworks, being so extremely inflammable that they burn with a kind of explosion when brought into contact with flame. This powder is likewise sold in the druggist's shops for preventing excoriation in young children, and for rolling pills in to prevent them sticking together. It is known as Lycopodium or Vegetable Sulphur, and under these names is imported in considerable quantity from the northern part of Europe, where it is more abundant than here." The medicinal properties of the plant have been extolled by our older writers, from Gerarde down to Dillenius, but the plant holds no place in the British Pharmacopœia. The spores of this plant are so repellent of moisture that if scattered over the surface of water in a basin a stone may be picked from the bottom without wetting the hand. Lightfoot, in his "Flora Scotica," says that "The Swedes make mats of the club moss to rub their feet on." Newman, in "The Phytologist," i, p. 5, seems to discredit this statement. He says, "If this be true, it is remarkable that the fact should have escaped the notice of such observant men as Linnæus and Wahlenberg." Mr. J. B. Stone, however, assures me that he saw such mats made of *Lycopodium clavatum* and offered for sale, during his last journey through Norway.—J. E. Bagnall.

Reports of Societies.

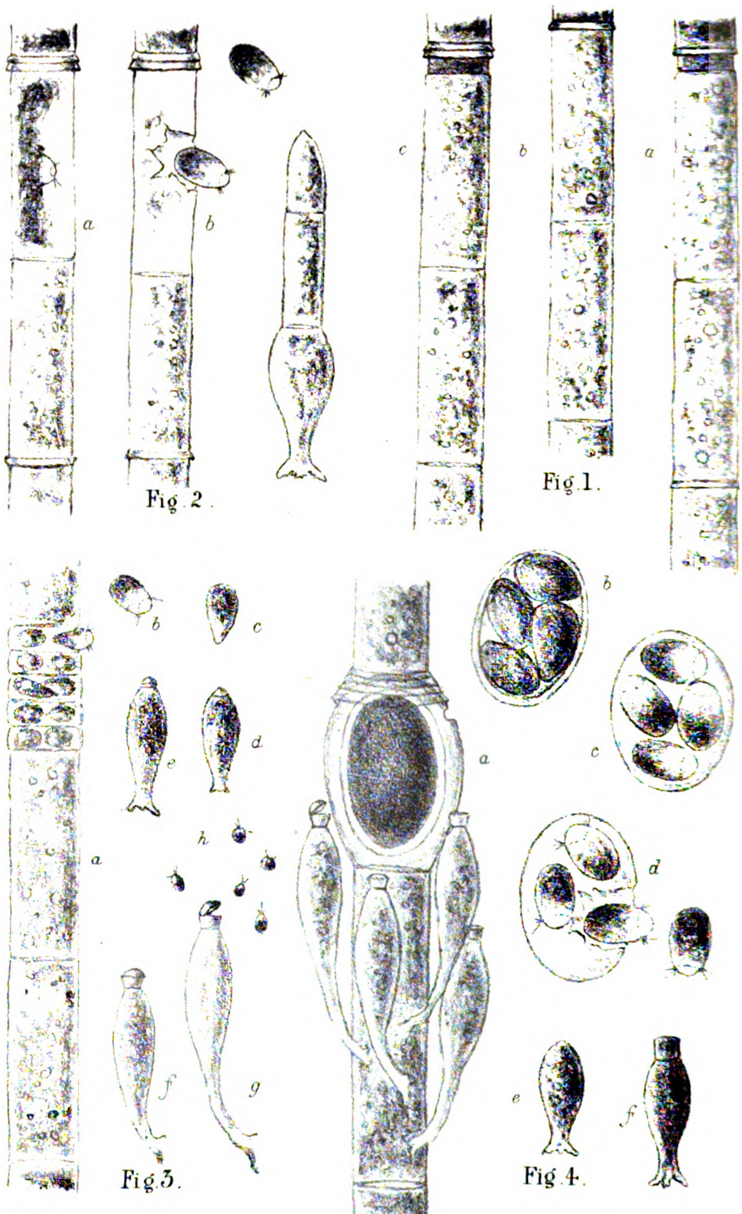
BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section.—January 27th.—Mr. R. W. Chase in the chair. Mr. Chas. Elcock, of Belfast, exhibited seven type slides of foraminifera—two of fifty different species each, four of different species each, of different orders—*Miliolidæ*, *Hyaline*, *Porcellanous*, and *Lagena;* one of thirteen different species of the Arenaceous order;

and several species of living foraminifera. ANNUAL MEETING, February 3rd.—Mr. T. H. Waller, B.A., B.Sc., presided. The twenty-sixth annual report of the committee, which was read by the Chairman, referred with pleasure to the very valuable work which had been done during the past year. It was with pleasure that the committee recorded the honour conferred upon Mr. J. E. Bagnall by his being elected an Associate of the Linnean Society in recognition of his valuable original work in the various branches of botanical science. He was one of the oldest members of that society, and had rendered to it most useful service, his papers on Bryology and his "Flora of Warwickshire" having gained for him a reputation far beyond his native town. At the end of 1883 the society numbered 300 members. The total number of members and associates was now 288, being a decrease of twelve. The reports of the proceedings of the different sections were also presented. The statement of accounts, which was read by the Treasurer (Mr. C. Pumphrey), showed an expenditure of £293 18s. 10½d. for the past year, and there was a sum of £60 owing to the treasurer. The deficiency, it was explained, was due to arrears of subscriptions. The election of officers for the ensuing year was then proceeded with. Mr. R. W. Chase was elected president, Mr. J. E. Bagnall and Professor Hillhouse vice-presidents, Mr. C. Pumphrey treasurer, Mr. W. B. Grove librarian, and Messrs. Morley and Wilkinson hon. secretaries. BIOLOGICAL SECTION.—February 10th. Mr. J. Morley in the chair. Mr. W. H. Wilkinson exhibited mounted specimens of *Batrachospermum moniliforme*, var. *Boltoni*, the new variety recently found by Mr. T. Bolton. Mr. J. E. Bagnall mosses, *Scleropodium cæspitosum*, in fruit, from near Brinklow, very rare in fruit. For Mr. J. B. Stone, mosses, *Eurhynchium circinatum* and *Orthotrichum saxatile* from Tenby. For Mr. R. Rogers. *Pleuridium subulatum* and other mosses from Hampton-in-Arden. For Mr. Frederick Enock, *Lycopodium clavatum* (wolf's claw), and an abnormal condition of the male flowers of the common hazel, *Corylus Avellana*, in which a cone-like body was formed of about seventy-five of the catkins. Mr. R. W. Chase then gave his short notes upon *Panurus biarmicus* (bearded Tit), with specimens showing their life history, from observations made in Norfolk, illustrating his remarks by specimens in various stages, also nests and eggs. He stated that owing to the drainage of the fens the localities suitable to this beautiful species are annually becoming more limited, and afterwards described the nest, which is placed nearly on the ground amongst the reeds and other aquatic foliage, but not attached to them. Nidification commences about the first week in April, but owing to the demand for eggs the marshmen rarely allow the first clutches to hatch, consequently eggs can be taken as late as July. He concluded with a description of their habits, food, and internal construction. A discussion followed, in which Messrs. Wilkinson, Morley, France, Udall, Grove, Pumphrey, and Bagnall took part.

THE BIRMINGHAM MICROSCOPISTS AND NATURALISTS' UNION.—January 19th.—Mr. Moore exhibited specimens of Burying Beetle, *Necrophorus vespillo;* also gizzard of the same under the microscope. The following objects were also shown under microscopes:—Mr. Rodgers, a marine alga, *Ceramium strictum;* Mr. J. W. Neville, *Bicellaria ciliata* and *Catenicella margaritacea*, Australian polyzoa; Mr. Hawkes, calcareous granules from *Arion ater*. January 26th.—The President, Mr. Beale, exhibited a skull of Bottle-nosed Porpoise; Mr. Madison, *Terebratula caput-serpentis*, and other shells from Oban.

Under the microscopes, Mr. Moore, specimens of wasp paper, showing in some pieces bands of scalariform tissue, and in others a utilisation of insect remains; Mr. J. W. Neville, *Flustra episcopalis*, from New Zealand; Mr. Rodgers, stellate hairs of Elæagnus; Mr. Hawkes, sponge spicules, *Muricea luniformis*; Mr. Grew, flea of Hedgehog, *Pulex erinacei*. February 2nd.—Mr. Moore showed under the microscope first and third leg of Honey Bee, with pollen brush and basket; Mr. J. W. Neville, larva of *Orgyia pudibunda*, mounted whole, popularly known as the Hop Dog. Mr. W. Tylar then read a paper, "Notes on the Hydra," which traced the early history of observations on this polype, and described the four kinds found in this country. The peculiarities of their structure were noticed at some length, with the various kinds of thread-cells, some so small as only to be seen with very high objectives; supposed muscular and nervous system; and the simplicity of their digestive organs. The paper also described their power of repairing injury and building up a complete polype from a small part, their various modes of reproduction, and the parasites frequenting them; and concluded by describing a ready method of killing them with their tentacles extended, and the most suitable medium for mounting them in. The paper was illustrated by diagrams and microscopic preparations. February 9th.—Mr. Hawkes exhibited a specimen of large Mussel and other shells from Peru; also specimens of silver ore. Under the microscopes Mr. Tylar showed crystals of oxalate of potash; Mr. Moore, pulmonary plates of Spider, stained; Mr. J. W. Neville, Oak Apple Fly, *Cynips terminalis*; Mr. Sanderson, spores of a New Zealand Fern, *Steichenia flabellata*; Mr. Hawkes, *Gamasus coleopterorum*. February 16th.—Mr. Moore exhibited a collection of Ichneumon Flies and their nests. Under the microscopes, Mr. Tylar, transverse section of Rat's tongue, injected, and *Hydra vulgaris* stained with osmic acid, showing filaments projecting from thread cells. Mr. J. A. Grew then read a paper, "Insect Tragedies," which pointed out that the classification of insects had received more attention than their habits, economy, and instincts, and described the predacious habits of many, both in the larval and imago stage; showing that from the number of their foes an extraordinary fecundity was a necessity against their extermination. The paper concluded by describing some uses of insects, certain protective disguises, and the necessity of Nature preserving a balance of power.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D.—ZOOLOGY AND BOTANY.—Chairman: F. T. Mott, F.R.G.S. MONTHLY MEETING, February 18th. Attendance, fourteen (five ladies). Exhibits: Fruit of a cucurbitaceous plant from Madeira, called "Chou-chou," used as a vegetable; specimen of the fresh-water shell (*Planorbis corneus*) from the Soar, near Leicester, by the Chairman; a parasitic mite from the common house-fly, mounted as a microscopic slide, by Mr. Grundy. Paper, by the Chairman, "On the weapons of animals," showing how carnivorous habits necessitate the use of weapons both of offence and defence; describing how nearly every external organ of the body has been modified for this purpose under various conditions of life; how a variety of special growths in the shape of horns, spurs, stings, &c., have also been developed in certain families; and how man, though the most widely spread and most omnivorous of large animals, is the most naturally defenceless, his superior brain power enabling him to provide artificial weapons and so to keep his limbs in the best condition for other uses.



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ŒDOGONIUM CRASSIUSCULUM

LIFE HISTORY OF A FILIFORM ALGA (*ŒDOGONIUM*).

BY M. C. COOKE, M.A., A.L.S.

(Continued from page 76.)

Having for the time disposed of the ordinary cells such as are observed in both the sterile and fertile condition of the plant, we now return to the microscope and look along the threads in search of any divergence from this ordinary condition of vegetative cells. And, supposing the threads to be in the fertile state in which we found them, we soon become conscious of the presence of certain special cells interspersed amongst the rest, which are broader, more oval, and contain within them not the granular cell contents, but a large, opaque, definite, somewhat globose body, of a dark colour, which we will call a spore. Its proper designation is oospore, or a spore produced in an ovarian sac, or cell, which sac, or cell, is termed the oogonium. The oogonium is a little larger than the oospore but of the same form, and the oospore lies free within it, being at first greenish and granular but at length invested with a brown coat, which again has an outer transparent layer more or less thick, according to the species. Concerning ourselves only with this one species of *Œdogonium*, we find it producing nearly elliptical brown oospores, with a very thick hyaline outer coat, hence called *crassiusculum*. One

PLATE III.

DESCRIPTION OF THE FIGURES.

Fig. 1.—Illustrations of the growth of new cells. At *a* it has just commenced, leaving a ring at the apex of the daughter cell; *b*, the daughter cell has attained an equal size to the mother cell; at *c* a second new cell has commenced, bearing the first and second ring at its apex. × 200.

Fig. 2.—Asexual reproduction; *a*, zoospore being formed in mother cell; *b*, zoospore escaping by rupture of the mother cell; *c*, germinating asexual zoospore. × 200.

Fig. 3.—*a*, androsporangia of *Œ. crassiusculum*; *b*, androspore; *c*, the same, with the cilia absorbed; *d*, *e*, *f*, *g*, successive stages in the development of dwarf males from the androspore; *h*, spermatia. × 200.

Fig. 4.—*a*, portion of filament of the Œdogonium, with oospore in the oogonium, and four dwarf males attached to the supporting cell; *b*, *c*, *d*, formation of four sexually produced zoospores from the fertilised ospore; *e*, zoospore at rest, and attached at its base; *f*, commencement of growth of the first cell of the young *Œdogonium*. × 200.

thread may have several oogonia, although they are usually scattered over the filament, and not contiguous. The striæ, or caps, at the apex of the oogonium indicate that the oospore has been developed in one of the youngest cells. Near the top, or certainly above the middle of the oogonium, is a small hole perforated through the wall of the oogonium. It is through this opening only that any small body can find entrance to the enclosed oospore, and it is through this opening that fertilisation is effected.

Leaving the oogonia for a while, we will traverse with our eyes one of the filaments, to see if we can trace any other cell modification, and by careful observation we at length find from four to six short cells, not more than half as long as broad, lying together in one part of the filament towards the apex, the whole six short cells not occupying so much in length as any one of the vegetative cells. These short cells are the spore cells, or androsporangia, of the male organs. As there is no other similar mode of reproduction amongst Algæ, and this rather a complicated one, I must ask you to follow me into the details of the process.

I have said that these four, five, or six short cells in the filaments are destined to produce the male organs; the female, or oogonium, containing the oospore, or unfertilised egg, being seated in the same filament, lower down. When mature and the fulness of time is come, the outer wall of each of these short cells, or androsporangia, is ruptured, and about two zoospores of a peculiar kind called androspores make their escape. These are green oval bodies, paler at one end, where they are furnished with a fringe of movable cilia. By means of these cilia, the newly-escaped zoospores move about in the water actively for a time, apparently enjoying their freedom, until at length they grow more and more sluggish until finally they attach themselves by the paler end, and another change takes place. It must be remarked here, that when these zoospores escape from their androsporangia, on a roving commission, they evidently have a definite work to accomplish, although they appear to be only indulging in frivolous pastime, because when they settle down and attach themselves by their paler end and abandon all frivolity, they invariably fix themselves to the cell immediately beneath the oogonium. I will leave you to explain or moralise upon this fact as you please, but to me it is one of extreme suggestiveness, that two or three or half-a-dozen active little bodies, without sense or sensibility, or instinct, should quit their parent cells and travel down the filament, it may be for half its length, and then attach themselves, not to any promiscuous cell which may be near them, but to the cell which immediately joins the oogonium, and not by mistake the cell above, but the cell below the oogonium, and there remain permanently fixed. What is the attraction powerful enough to draw them to this spot, and no other? "Surely there are more things in heaven and in earth than are dreamt of in your philosophy."

We have followed the androspores from their parent cell until they attach themselves to the cell immediately beneath the oogonium. When they have done so the base elongates into a kind of stem; the upper portion also grows and elongates until it assumes more or less a club-shaped form. The apex narrows into a mouth, covered with an operculum, or movable lid. Meanwhile active little spermatozoids are being formed in the interior, and the androspores are converted into little male plants (nannandres), clustered around the oogonium, ready at any moment for their spermatozoids to escape and enter the little opening in the wall of the oogonium to fertilise the oospore which it contains. Thus, then, we trace this process; the formation of an ovum or unfertilised spore in its ovarian sac or oogonium, and the same thread producing androspores (or spores of male plants) which escape and then attach themselves close beneath the oogonium, produce their own spermatozoids, which in fulness of time issue at the apex, by the falling off of a deciduous operculum, and immediately enter the aperture of the adjacent oogonium and fertilise the oospore. This work being accomplished, the male plants have no other mission in this world, therefore they dry up and wither away, whilst the oospore, now rendered fertile, passes through a period of rest and in due time produces a new generation.

From these fertilized oospores we may now follow the young plants until we reach the point at which our history commenced and the cycle is complete.

Before completing this history, we may make a diversion here to explain another method of reproduction which prevails in this interesting genus of aquatic plants. We have hitherto been watching a truly sexual reproduction in which male and female elements perform their part, but in this other method there is no visible evidence of sexuality; it is, as far as we can judge, a purely asexual or nonsexual reproduction, analogous to budding in higher plants.

In this method for the continuance of its species, any cell in an ordinary vegetative filament will serve. In one of these cells there is a turbulence in the cell contents, which at length, draw closer together, and in a short time an ovate body is formed similar in size and appearance to the androspores, from which the dwarf male plants are seen to be produced. This ovate body, nestling within its parent cell, is seen to be furnished near its paler apex with vibratile cilia. When mature, the enclosing cell is ruptured, and the imprisoned zoospore, endowed with active motion, makes its escape. In its movements through the water it seems impossible to distinguish this new zoospore from the zoospores, or androspores, of the short cells. Like them, it moves about for some time, then becomes sluggish, and ultimately comes to rest. The cilia are absorbed, and the pale end of the zoospore is attached to some object but not as in the previous instance to any special cell of the parent plant, nor in any proximity to the oogonium. Alike as they are in size, form, and movement, they are different in their origin and in their destiny.

When, at length, these asexually produced zoospores come to rest, they form at the base a kind of clasping radicle, or more or less lobed expansion, by means of which they attach themselves; then there follows a lengthening or expansion upwards, which in process of time is cut off by a septum from the basal cell, and becomes the first cell of a new plant, or rather the second, including the basal cell, which is persistent and remains through the whole life of the plant. Hence the basal cell in all perfect filaments of Œdogonium threads, whether proceeding from an asexual zoospore or the zoospores of a resting spore, is always more or less bulging, or clavate, with a spreading, discoid, or somewhat lobed base. It is unnecessary to follow the growth of this young plant into a filament, in all respects resembling its parent.

We now return to the fertilised resting spores from which we recently diverged. We will suppose that the old plant has decayed and nothing remains but these quiescent spores, which are now sunk to the bottom of the pond or nestling in the axils of some aquatic plant. In due time, but always after some period of rest, these spores exhibit evidences of vitality, at first by becoming more greenish in color. And soon it will be found that a special membrane has been formed around the cell contents. Upon germination slit-like openings are formed in the old spore membrane, and the new inner membrane, and the contents escape, surrounded by an exceedingly delicate covering. The contents are now not a single oval body, but composed of four greenish oval masses, each surrounded by a hyaline membrane. Now and then, by abortion, there are only two or three oval masses, but the normal number is four. After the four cells have remained some time enclosed in the hyaline covering, this becomes subsequently reabsorbed, and the four cells lie still and motionless. After a short time they break at one end by a circular slit, and the apex separating becomes elevated like a lid. Through this opening the contents emerge in the form of an oval zoospore, paler at the foremost end, which is furnished with movable cilia. Thus four active zoospores are normally the produce of one oospore, and these are in all respects similar in size, form, and movement to those we have seen originating male organs, or produced, asexually, from the cells of the filament. From this point, the same process is repeated. The zoospores move about freely for a time in the water, they then gradually become more sluggish, finally they become still, the pale end is directed downwards, the cilia are absorbed, an expansion like a radicle is formed, and by this it is fixed. Then the upper portion elongates, the apex becomes a growing point, a septum cuts off the first new cell, and a young plant has fairly started on its career, to produce in its turn its own oospores, androspores, and asexual zoospores, even as its parent had done.

We have now traced the life history of *Œdogonium crassiusculum*, and, as far as we can judge, the cycle seems to be tolerably complete. We have had to guess at nothing and to assume nothing; the continuity is unbroken, and, strange as some of the phenomena may be, there is no offence against our judgment or our experience, and no reasonable foundation for doubt.

To such a story it is unnecessary for me to append a moral at the end, such as we find in all goody-goody books for goody-goody boys and girls. Yet, I cannot help asking you, as naturalists, whether organisms about which such a history can be written do not deserve a more widely extended study than they as yet receive. Any of you may take a phial in your pocket and trudge to Sutton Park. If you have none other, utilise that which held your last "black draught." If that fails, be content with a pill box, or even a square of brown paper. There are certainly some half a dozen species to be found there. By perseverance and experience you may find them all, and trace out their history. You require no elaborate apparatus, only three things, all of which are essential:—(1) A microscope; (2) ability to use it; and (3) a good resolution. With these no one needs to fail.

This may be a humble organism that I have brought to your notice, it may be a low form of vegetable life, one of the lower Cryptogamia—facts which I am not prepared to dispute. They live, vegetate, thrive; some in rather dirty places, collecting their own food, supporting themselves by the exercise of their own powers, pass through childhood, youth, manhood, and age; enjoy the pleasures and sorrows of conjugal life, but with only one object, as far as we can see, although in æsthetic eyes they may have a higher—to live and reproduce their species, to increase and multiply, and replenish the waters. Of how many higher organisms could we say—nothing more.

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

(*Continued from page 66.*)

North of Tilton Station, at Halstead, there is an extensive working of the West Yorkshire Iron Company in the upper beds of the weathered Marlstone at its outcrop on the hillside. The Marlstone Rock and underlying shales are also well shown in the railway cuttings immediately north of Tilton Station. In the neighbourhood of Billesdon there are several interesting exposures of the Rock-bed, which, in that neighbourhood, attains a thickness of over twenty feet. Billesdon Coplow, a hill famous in hunting annals itself, bears a small capping of this stone. Going south from Tilton the Marlstone Rock can be traced as a terrace on the hill sides by Lodington and East Norton to Allexton and Stockerston and thence by Hallaton to Slawston and Medbourn. In this direction a great change takes place, the Rock-bed thinning away very rapidly. At Billesdon and Tilton the Marlstone Rock is from eighteen to twenty feet in thickness, but at Allexton it is only two feet, and between Keythorpe and Hallaton not more than one foot in thickness. In the neighbourhood of Cranhoe, Hallaton, and Blaston the Rock-bed is so thin as to be scarcely traceable; it has, however, been observed in the outliers of Slawston Hill, Staunton Hill, and Great Bowden. South of the Welland the Marlstone reappears in a modified and attenuated form at Ashley Sutton Basset and Market Harborough, and three or four miles west of this latter place it forms an outlier between Gumley and Laughton.

To the north of Melton Mowbray the Marlstone constitutes a considerable outlier at Holwell. It is extensively quarried in the vicinity of that village by the Holwell Iron Company and the Stanton Coal and Iron Company. The ordinary ferruginous stone alternates with brashy shell beds or jacks, and a few local blue-hearted encrinital bands. The ironstone is here well jointed, a feature which facilitates its extraction. The lower arenaceous and unproductive beds appear in a railway cutting in one of the quarries, faulted against the ferruginous beds.

From Holwell the Marlstone extends westwards by Wartnaby to Green Hill, near Old Dalby. At Wartnaby it is worked close to the edge of the escarpment by the Stanton Iron Company. The stone is friable, and contains very few fossils; this, however, is no disadvantage from an ironmaster's point of view. The ore is taken away by a short mineral line to a tip on the Nottingham and Melton (Midland) line at Old Dalby.

From Green Hill the Marlstone extends eastwards in a fine line of escarpment to the railway tunnel at Long Clawson. At this point the Rock-bed and underlying Lias shales have been broken through and their place occupied by boulder clay to a depth of nearly one hundred feet. From Long Clawson the Marlstone Rock bends round to the north-east along the well-wooded heights of the Belvoir Hills to Belvoir Castle, that noble edifice itself crowning a diminutive outlier of this rock. On the way we pass the extensive workings of the Eastwell Iron Company, situate at the edge of the escarpment, about two miles south of Stathern Station. The ironstone here is porous and highly absorbent, containing as much as 25 per cent. of moisture, and is but slightly fossiliferous. It is quarried along two working faces nearly half-a-mile in length. At the crest of the hill the cutting for the tram incline, by which the ironstone is taken on to the Great Northern Railway below, shows the Marlstone Rock, of which twenty-five feet are exposed, resting on Middle Lias shales.

At the time of writing ferruginous marlstone is also exposed in the cuttings of the Eastwell branch of the Great Northern Railway, and also of their Eaton branch, north of its junction with the Eastwell branch. At Black's Barn, a little south of the Eaton viaduct, the Marlstone, twenty-four feet thick, was penetrated in a well beneath thirty feet of boulder clay. The Holwell Iron Company are now working the stone by the side of the new line at Eaton, and the Staveley Company and Messrs. Oakes and Company near Swaine's Lodge, about a mile further north. In the Belvoir district there are numerous exposures of the Marlstone Rock, chiefly in small roadside quarries. Of these we will notice a single one, viz., the Duke's Farm Quarry, near Woolsthorpe Old Church, in order to illustrate the character of the stone in this neighbourhood.

Section in Marlstone at the Duke's Farm Quarry, near Belvoir.

			Ft.	In.
Soil and rubble			3	0
Ferruginous marlstone, thinly laminated with dark ferruginous streaks			4	9
Fossiliferous bed "jack"			0	9
Ferruginous marlstone			1	0
Second "jack"	0	9	1	2
Ferruginous marlstone, Am. spinatus, Pecten lunularis, P. æquivalvis, Lima pectinoides, Modiola scalprum, Belemnites elongatus, Terebratula punctata, and var., Rhynchonella tetraedra	0	9	1	0
Arenaceous beds (unproductive), massive open jointed, unfossiliferous, blue-centred rock ...			5	4
Rubbly stone			1	0
			18	0

To the south of Belvoir the Marlstone Rock is exposed in the quarries of Woolsthorpe, Knipton, and Branston, and in all of these the junction of the ferruginous and arenaceous beds is very sharply defined. On the high ground opposite Belvoir Castle the Marlstone is worked in a field south of Woolsthorpe Cliff Wood, by the Stanton Coal and Iron Company. Throughout this extensive area, that is to say between Holwell and Scalford on the south, and Woolsthorpe and Denton on the north, or broadly speaking, in the district lying between Melton Mowbray and Grantham, the Marlstone Rock maintains an average thickness of from twenty-five to thirty feet. Over the greater part of this area the upper or iron-bearing beds, generally in a thoroughly weathered or oxidised and friable condition, very favourable for working, are well represented. It is in the above district that the Marlstone is now coming most extensively into the market as an iron-producing rock. Towards this end, very material assistance will be rendered by the new mineral lines of the Great Northern Railway, namely the Eaton and Eastwell branches of the Waltham branch, now rapidly approaching completion, the Woolsthorpe branch of the Nottingham and Grantham line, with its projected extension through Denton to Harston, and by the Midland Railway Company's Holwell Extension branch of their Nottingham and Melton line. At the present time the ironstone is being worked by the Holwell Iron Company, the Eastwell Iron Company, the Stanton Coal and Iron Company, the Staveley Coal and Iron Company, and Messrs. Oakes and Company. In the course of time, no doubt, other large North-Midland ironmasters will be induced to make a venture in this very accessible and highly productive ironstone region.

From Woolsthorpe the Marlstone Rock extends by Denton and Harlaxton in Leicestershire to Grantham, and by Barrowby and Great Gonerby to Caythorpe and Welbourn in Lincolnshire. The escarpment due to this rock falls all the way from Woolsthorpe coincidently with the dip of the beds, coupled with a certain amount of attenuation. At Caythorpe the ironstone is being extensively quarried by the West Yorkshire Iron Company and the Stanton Iron Company.

Section in the Marlstone at Caythorpe, near Grantham.

	Ft.	In.
Soil	5	0
Ironstone, thinly laminated, encrinital and shelly beds obliquely laminated	1	0
Ironstone, calcareous rock with ferruginous streaks	0	8
Do. do. with local blue-hearted streaks	2	0
Ironstone, with ferruginous and shelly layers in equal proportions	1	0
Ironstone (good quality)	0	6
Do. shelly	1	2
Fossiliferous bed, "jack," hard blue thinly laminated	0	6
Ferruginous ironstone to base	1	0
	12	10

The ironstone at this place contains an excess of carbonate of lime, analysis showing Calcic carbonate 62·14, and Ferric oxide 25·71. This stone, therefore, is found valuable to mix with ores less rich in lime. The Bestwood Coal and Iron Company use it advantageously in conjunction with the more earthy Eastwell ironstone, and the siliceous Northamptonshire iron ore from Weldon. Beyond Caythorpe the Rock-bed is much reduced in thickness, and its outcrop becomes very narrow. At Leadenham the rock is not more than ten feet thick, though it still forms a feature. In the station yard at this place a few ferruginous flaggy beds are seen resting on compact sandstone. North of Leadenham the Rock-bed rapidly attenuates, and it soon becomes merged in the sloping ground at the foot of the oolitic escarpment. Finally, the Marlstone thins out altogether at Welbourn, and it does not apparently set in again until we reach the village of Burton, near Lincoln, about twelve miles to the north of this place, and then not in a workable form.

(To be continued.)

THE PHYSIOLOGY OF THE MEDICINAL LEECH.*

BY JOHN B. HAYCRAFT, M.B., B.SC., F.R.S. (EDIN.), PROF. OF PHYSIOLOGY, MASON COLLEGE, BIRMINGHAM.

When blood is withdrawn from the body it coagulates in a few minutes, and forms a solid mass. Not only is this seen in the cup into which the blood may have been shed, but occurs also in the region of the wound, filling this up, and plugging the little vessels which have been cut. But for this coagulation we should bleed to death from the slightest wound. Sometimes the blood loses its power to clot, and very serious consequences ensue. The study of coagulation is, therefore, very important, and physiologists and medical men have paid much attention to its investigation.

While thinking over some obscure questions connected with this matter, in the autumn of 1883, I recalled a fact familiar to every surgeon, viz., that after a leech bite the blood flows from the wound, and is very difficult to staunch; and moreover that the blood which the leech has sucked remains permanently fluid within its stomach. So much was known at that time about the coagulation that I was able to predict an explanation of these curious and hitherto unexplained facts, which my experiments enabled me to confirm. These I will now describe, confining myself to those points which will be of most interest to the general biologist.

A blood-clot consists of a sponge of albumen (fibrin) which encloses the corpuscles in its meshes. When shed from the body the blood contains red and white microscopic particles—corpuscles—floating in a fluid—the liquor sanguinis. Very soon the white corpuscles form small quantities of a very active substance, a kind of ferment, which acts on the liquor sanguinis, and causes the formation in it of this sponge of fibrin. Now this is prevented in some way by the leech.

If you cut out with a pair of sharp-pointed scissors the sucker and gullet of a leech, and after chopping these into very small pieces, place them for an hour or so in very weak salt solution, you will obtain a watery solution, a specimen of which I show you in this bottle. If I add a drop of this to a few drops of blood freshly drawn it will remain quite fluid, while this similar portion will clot in a few minutes.

* Transactions of the Birmingham Natural History and Microscopical Society. Abstract of an Address, read December 9th, 1884.

We have extracted from the leech then a substance which prevents coagulation. What is it? I am not in a position to answer this question. I have tried to find out, and one of the most distinguished of the German chemists, Professor Schmiedeberg, has tried also, but without success. The smallest quantity only is present, but it has an action on the blood as powerful in its way as the venom of the rattlesnake. A quantity of the substance, obtained as yet in an impure state, less than a grain in weight, will prevent a gallon of blood from clotting.

This substance the leech secretes from its sucker; and if this organ be examined with a microscope, a large number of little glands will be seen opening on its surface. These are single cells and they may be compared with the salivary glands of man, and their secretion—containing the substance—with the saliva.

The saliva of the leech prevents coagulation. How does it operate? It kills the ferment which produces the fibrin from the liquor sanguinis. The experiments conducted in order to prove this point would take long to describe, but I may mention that the saliva although it kills the ferment does not kill the cells which produce it. If a drop of blood be mixed with a drop of this extract of leech saliva and examined with the microscope, carefully warming the preparation with suitable apparatus, the little white corpuscles will be seen moving about as in normal blood.

In this preparation you will see the blood of a crab under the microscope. There are a mass of white corpuscles—no red ones exist—welded together by processes of their protoplasm called pseudopodia. This forms the clot seen in invertebrate blood, which is then due not to the formation of fibrin, but to the fusion of the white corpuscles. We have seen that in human blood the leech saliva does not affect the white corpuscles. These are homologous of those of the crab just alluded to, and we should anticipate then that the saliva will not prevent the clotting of crab's blood. This is the case.

If a small quantity of the extract be injected into the jugular vein of a rabbit or dog the animal will be thrown into a very curious condition, in which it resembles a patient suffering from a disease called hæmophilia. The slightest wound in the skin continues to bleed. In hæmophilia this may lead to fatal consequences, but as the leech saliva is eliminated pretty rapidly from the system, its injection is not so very serious a matter.

Now you will be in a position to see the reason *why* the blood continues to flow for so long a time from the leech-bite. In this case there is a local injection of the secretion into the tissues of the wound, and a local effect only is produced. While the leech is sucking, this secretion bathes the wound, and being very diffusible it passes into the tissues around. When the leech drops off at the end of ten or fifteen minutes, the wound is literally soaked with the secretion, and the blood not only flows from the wound, but some of it will probably find its way into the tissues around its edges, so that the skin becomes blue just as if it had been bruised—(this is generally but not always seen). If you wish to stop a leech bite you must wash the wound well with water to wash away the secretion.

To the leech, the possession of this secretion is essential for its existence. It thus obtains sufficient blood for its nourishment. A cut such as the leech can inflict would very soon stop bleeding, and the creature would at most obtain a few drops. But in addition the blood remains fluid within its body cavity. We know—many at least—by our own experience how difficult it is to digest a milk-clot; for the coagulation of the milk within the stomach is perhaps the chief reason that it is to some a forbidden article of food. So with the leech; it can easily assimilate the fluid blood, but its digestive juices would refuse to attack a solid blood-clot.

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(Continued from page 73.)

5.—*The Silurians of Walsall.*—Ten miles due west of Dosthill, the intervening space being occupied by the Trias, we find a considerable area of Upper Silurian beds lying around and east of Walsall. The lowest stratum exposed is the *Upper Llandovery or May Hill Sandstone*, which crops out near Hay Head and at Shustoke Lodge, two miles east of Walsall.* It is here very fossiliferous, and has a westerly dip. The rocks which lie below it are not visible, but if the fault which has brought the May Hill Sandstone to the surface had had but a little greater throw, we should, doubtless, have found Cambrian or Pre-Cambrian rocks at the surface, for the entire thickness of the Lower Silurian strata is wanting in this part of South Staffordshire.

* Jukes' South Staffordshire Coalfield; Suney Memoir; p. 109.

The overlying beds include the Barr or Hay Head (Woolhope) limestone; then 800ft. of Wenlock shales (well shown in the railway cuttings); and lastly, at Dun End and Walsall Town, the two bands of the Dudley (=Wenlock) limestone; these being immediately overlaid by coal-measures, the whole series of rocks dipping westerly.

6.—*The Silurians of Dudley and Sedgley.*—Crossing now to the western boundary of the South Staffordshire Coalfield, we find that also formed by a fault, which has again brought Silurian rocks to the surface. But as the throw of this fault is somewhat less than that of the eastern boundary, we here, at Sedgley, find the lowest rock exposed to be the *Wenlock Shales.* Above these come the two bands of Dudley (=Wenlock) limestone, then a great thickness, perhaps 1,000 feet, of *Ludlow Shales*, near the top of which we find the Sedgley (=Aymestry) limestone. Although the beds undulate, their *general* dip is to the east.

A little south of the Sedgley area the Silurian rocks again rise to the surface in the two dome-like masses of the Wren's Nest and Dudley Castle; here we get the Wenlock shales and limestone only. A little farther south there is a small exposure of the same beds at the Lye. Thus far we are able to see a strong resemblance between the structure of the South Staffordshire and the Warwickshire Coalfields. Each is bounded on the east and on the west by faults which run north and south, and by which the rocks lying beneath the coal measures are brought to the surface. The differences, however, are considerable. In Warwickshire the boundary line is a double fault, and the rocks brought up are Cambrians, while in Staffordshire they are Silurians. The coal-seams of Warwickshire, moreover, increase in depth from the surface, and pass beneath newer rocks as we follow them southward, and the southern boundary of that coalfield is unknown. But in Staffordshire just the opposite happens; we know that the coals there terminate in a southerly direction against a buried ridge of Silurian rocks, the actual outcrop of the seams being hidden by the upper coal measures which overlap. But a little further south these old Silurian rocks, and others of still greater antiquity, are brought to the surface in a manner which strongly reminds us of the Hartshill region.

7.—*The Lower Lickey Hills.*—The Lower Lickey Hills form part of the southern boundary of the South Staffordshire Coalfield. They consist of a low camel-backed ridge, some 500 feet in height, running from north-west to south-east for between two and three miles. Access is easy from the Barnt Green Station (at the southern end of the ridge), on the

Birmingham and Worcester line; while a new railway has lately been opened from Rubery (at the north end) to Halesowen.

The basement rock of the Lickey is best seen along a stream-course at the southern end of the hills. It is a greyish blotchy rock—probably an altered volcanic ash—which has harder (quartzose) bands in its upper part; only a small area is exposed, and there is no good section. This rock is probably of Pre-Cambrian age.

Next in order we get the hard, much-jointed, greyish-white to red quartzite, of which the main ridge is composed. It is well exposed in numerous sections—that at Rubery Station being especially fine—where it is worked for road-metal. The thickness of the quartzite is about 350 feet, and its prevailing dip is to the north-east, at angles of from twenty to thirty degrees. But at the Rubery end of the hills—where the section is most complete—the quartzite rolls over, and dips westward, thus forming a true anticlinal. No fossils occur in the quartz-rock, but whitish specks of decomposed felspar are common in it. At the southern end of the ridge the rock is much contorted. The geological age of the quartzite is again a matter of difficulty. Lithologically it is identical with the Hartshill quartzite, and rests, like it, upon Archæan strata. The Cambrian shales—which probably come above the quartzite—are here hidden by the overlap of the Silurian strata. The quartzite is, without doubt, either Cambrian or Pre-Cambrian, but, in the absence of fossils and of sections showing its relations to the rocks above and below it, it is hardly possible to refer it with certainty to its precise geological horizon.

Above the quartzite we find representatives of several Silurian rocks. First we get the May Hill Sandstone—a coarse, friable rock full of characteristic fossils, *Stricklandinia lirata* being especially numerous—which is well seen in the road-cutting at Snead's Heath, just opposite the wall of the Lunatic Asylum. Here the newer sandstone rests upon an eroded surface of the metamorphosed rock, filling up its hollows, and containing rounded pebbles of the quartzite. There are hard quartzose bands in the May Hill Sandstone, and these probably led to the erroneous idea—promulgated by Murchison and endorsed by the Geological Survey—that the Cambrian quartzite of the Lickey was simply a metamorphic form of the May Hill rock which reposed upon its flanks. The true facts of the case were observed by Professor Lapworth and Mr. Houghton early in 1882; the underlying Pre-Cambrian strata were discovered by the former geologist a little later, the clue to them being afforded by the rocks of like age which underlie the quartzite of Hartshill.

Above the May Hill Sandstone of the Lickey are Silurian shales with irregular bands of limestone representing the *Woolhope Limestone*, while at the southern end of the ridge, near Barnt Green, an old quarry in a wood reveals the *Wenlock Limestone.* At the northern end, where the anticlinal is complete, Silurian rocks occur on the east and on the west sides of Rubery Hill, and these are overlaid in turn by coal-measures. Above these come Permian and Triassic strata, which abound in fragments of the older rocks.

8.—*The Wrekin and Church Stretton District.*—The Pre-Carboniferous rocks of Shropshire have been so ably described by Dr. Callaway that it will be only necessary to briefly recapitulate his conclusions.

About twenty miles north-west of Dudley—at Lilleshall, in Shropshire—we reach the termination of an axis which extends from this point to the south-west for thirty or forty miles, and along which Cambrian and Pre-Cambrian rocks have been brought up on the east side of a line of fault. The Pre-Cambrian rocks were mapped by the Survey as intrusive greenstones, while the Cambrians were regarded as Silurian strata altered by the heat, &c., proceeding from the said greenstones at the time of the intrusion! Mr. S. Allport was the first to prove that the so-called greenstones were really bedded volcanic rocks.* They occur as isolated bosses at Lilleshall, the Wrekin Range, Wrockwardine, and Charlton Hill. Then there is an interval of six miles (occupied by Cambrian and Silurian strata) when the Pre-Cambrians again form the rounded hills north and east of Church Stretton, known as the Lawley, Caer Caradoc, Cardington Range, &c. The beds of altered volcanic ash, lava, &c., have a general strike from east to west, or *across* the direction of the ridges which they form.

Resting unconformably upon these volcanic rocks we find a quartzite, about 200 feet thick, identical in appearance with that of the Lickey and Hartshill.

Above the quartzite—where the section is most complete, as on the east side of the Wrekin—is the Hollybush Sandstone, greenish or brown in colour, and about 300 feet thick. Its fossils prove it to belong to the *Upper Lingula Flags*, so that it is of Upper Cambrian age. Above this sandstone, which is little altered, are the Shineton shales—bluish shale, 1,500 feet thick—containing many new species of fossils, which Dr. Callaway places on the horizon of the Lower Tremadoc Beds, and which must be of pretty nearly the same age as the Stockingford Shales of Warwickshire.

* Quarterly Journal Geological Society, Vol. XXXIII., p. 449.

Next come the Silurian strata, and we now meet, for the first time, with representatives of the Lower Silurian formation, in the shape of Caradoc sandstones and shales; but even these are not found north of the Severn, while the Arenig Beds and the Llandeilo Flags are still wanting. Neither is there any trace of the Lower Llandovery Beds, but the Upper Llandovery, or May Hill Sandstone, rests unconformably on all the rocks below it, while above it come all the Upper Silurians in due order—this is, indeed, their typical district—the Woolhope, Wenlock, and Aymestry Limestones forming long ridges, running from north-east to south-west (of which Wenlock Edge is the most prominent), while the softer shales form the valleys between. Then, west of Bridgnorth, and south of Broseley, we find the Old Red Sandstone here terminating its north-easterly extension. Of the Lower Carboniferous strata the Mountain Limestone and Millstone Grit are but feebly developed at Lilleshall and south-east of Wellington; while fifteen miles further south, in the Brown Clee Hills, the Coal-Measures repose upon the Old Red Sandstone.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

BY LEWIS J. MAJOR.

ABSTRACT OF CHAPTERS VIII. AND IX., VOL. I.

Heredity.

The universal law of Heredity is that each plant or animal produces plants or animals of the same general structure with itself, and though the various instances of heterogenesis, as given in the preceding chapter, are at first sight at variance with this law, they are not really so, the recurrence of forms being cyclical instead of direct. But the law of Heredity applies not only to main characters of structure but also to the smaller details, and though the tendency to repetition is qualified somewhat by the tendency to variation, the law may be considered as unlimited. Thus the members of any one sub-species habitually transmit their distinctive peculiarities to their descendants. We have, for example, several varieties of wheat, many varieties of potatoes and peas and of numerous other vegetables, not to speak of flowers.

Such variations from the original type would be impossible were it not that distinctive peculiarities, encouraged by a natural or artificial selection, have been and are habitually transmitted in an equal, in a greater, or in a less degree. In the absence of other evidence that which ethnology alone furnishes would suffice.

The illustrations of Heredity are then divided into two classes—(1) cases where congenital peculiarities, not traceable to any obvious causes, are bequeathed to descendants; (2) cases where peculiarities, not congenital, but resulting from changes in function during the lives of the individuals bequeathing them, are inherited. The necessity of this distinction is not very evident, and seems only to confuse, as there are many instances of Heredity which it would be difficult to place under one class more than the other. There are numerous instances of the inheritance of forms modified by natural and artificial selection, of the transmission of special deformities, of the inheritance of diseases, of peculiarities of skin and of teeth, &c., whilst the direct inheritance of an acquired peculiarity is sometimes observable. Mr. Lewes gives a case of a puppy that took to begging spontaneously (an accomplishment of his mother), and young pointers have been noticed to stand and point when first taken into the field.

[The inheritance of an acquired peculiarity can be by no means uncommon. Most people can recall instances of an inherited twitching of the mouth or eyes, of a peculiar way of shaking hands or even of holding a teacup, and of numerous other cases of the inheritance of the minutest details of habit. Darwin, in the expression of the emotions, gives a very singular instance—where a trick of lifting the arm and dropping it again with a jerk on to the nose, during sleep, was observed to be inherited.]

As an instance of functional Heredity, Spencer particularly cites the musical faculty, the growth of which he explains in a remarkably clear and powerful manner. There are two modifications of Heredity given on p. 252; atavism, and the limitation of Heredity by sex, to which we may add what Darwin styles a much more important rule than either of these, viz., that at whatever age a change appears in the parent, it appears in the offspring, *e.g.*, horns in cattle.

[Even peculiarities of structure will appear at the same age in the offspring as in the parents. In a family known to a friend of mine, with several members of two generations, one of the eye-teeth has failed to appear till they have reached twenty-two or twenty-three years of age.]

Variation.

No organism is exactly like its parent. Variation is co-extensive with Heredity, and the evidence which proves Heredity in its smaller manifestations is the evidence which proves variation, for it is only when there occur variations that anything beyond the transmission of structural peculiarities can be proved.

The transmission of variations is itself variable. An individual trait in one parent may be counteracted in the offspring, or may appear in an equal, or in a less, or in a higher degree. An instance of this is cited from Dr. Struthers of a family in which the transmission of digital increase was traced through four generations varying in position and degree.

Though unlikeness among progenitors is one antecedent of variation, it is by no means the only one, for successive offspring of the same parent are never exactly alike. This is accounted for by the functional variation of the parents, and is shown by the fact that twins are more nearly alike than children born in succession. But why are not seeds out of one pod and animals born at one birth exactly alike? There is another cause for variation yet to seek. In any series of dependent changes a small initial difference often works a marked difference in the result—instance the great likeness that exists between all babies a few weeks old. And again, no two parts of any aggregate can be similarly conditioned with respect to incident forces. Hence, no two ova, no two ovules, no two spermatozoa, no two pollen-cells can be identical, and the reproductive centres must begin to differentiate from the very outset.

The inferences from the power that organisms display of reproducing lost parts is, that the units of which an organism is built have an innate tendency to arrange themselves into the organism, but as reasons have been given for believing that the reproductive cells are not highly specialized, and it was actually seen in one of the organisms that the units of each undifferentiated cell were capable of arranging themselves into the form of species, we are driven to the assumption, as Spencer says:—

(1.) That sperm cells and germ cells are essentially nothing more than vehicles in which are contained small groups of the physiological units in a fit state for obeying their proclivity towards the structural arrangement of the species they belong to.

(2.) That the likeness of any organism to either parent is conveyed by the special tendencies of the units derived from the parents.

(3.) That in the progress of evolution of the fertilised germ, the two kinds of units are working in unison to produce an organism of the species from which they were derived, but in antagonism to produce copies of the respective parent organisms.

NOTES ON THE NATURAL HISTORY OF SUTTON PARK

(SITUATED IN THE NORTH-WEST EXTREMITY OF THE COUNTY OF WARWICK).

BY W. HARCOURT BATH.

The Bittern.—Although a rare occasional visitor, I believe the bittern had never been known to breed in these parts until last year, when I had the fortune to discover its nest. The haunt of this bird was in a thick wooded morass at the head of one of our largest pools, which it is almost impossible for anyone to penetrate except after an absence of rain for several weeks. During some fine weather in June last year I was engaged in exploring this bog in quest of information. I entered from the land side, and after some time and care spent in springing from one clump of reeds to another in order to evade the water, in doing which I was obliged to guide myself with the branches of the trees, I managed to arrive close to the water's edge.

The nest was about a yard from the pool, and was difficult to discern at first sight, as it was almost entirely obscured from view by the quantity of vegetation growing around it.

It was built very high up out of the water on a mass of reeds, in order to protect it, I presume, from a sudden rising of the water to which these bogs are very liable. It was composed exclusively of sticks and reeds, the inside being lined with the latter. In size it was somewhat similar to that of a coot's nest.

The eggs were partially hidden from view by a thin layer of reeds, which had the appearance of having been hurriedly put on in order to prevent their detection.

On removing this I found the eggs five in number and all quite warm, which proves that the parent bird must have left them only at the last minute.

The colour of the eggs is pale ochreous-brown, and their shape is similar at each end. They may be readily distinguished from the egg of any other bird on account of their soft velvety touch and beautiful glossy appearance.

The Black Tern.—A pair of these birds has the last two years been known to breed in one of the marshes, but at present I have been unable to discover the whereabouts of their nest.

They arrive here about the end of April or beginning of May. A single specimen was shot on one of the pools in the summer of 1882.

Long-Eared Owl.—Each year since my residence at Sutton I have been accustomed to find the nest of this bird.

Its situation is usually selected about the end of February or beginning of March, and about a week later the eggs, from four to six in number, are laid, and ten or twelve days afterwards the birds commence sitting. This bird never builds a nest of its own, but appropriates some disused nest of a crow, sparrow hawk, or magpie, entwining among the sticks a little dried grass, and on this placing a mass of feathers which the old bird plucks from its own breast.

The young are full fledged towards the end of April, and in May and June may be seen on moonlight nights in company with their parents scouring the woods in search of prey. They very seldom show themselves in the open, though I have seen them on several occasions. Their food consists principally of small birds, mice, and shrews, judging from the quantity of pellets found in their haunts.

During the day, the long-eared owl is very sluggish, and may be approached within a very short distance, but it is seldom seen in the day time, except on rare occasions, as it effectually hides itself in the thickest parts of the woods, and bears such a close resemblance to the trunks of trees in colour.

When disturbed off its nest, it almost invariably drops down immediately into the bushes, and very seldom flies far away, except on an exceptionally dull day.

I have never heard this species of owl utter a call.

The Kestrel.—It is rather singular that this bird in North Warwickshire, and especially in the neighbourhood of Sutton, should be of less frequent occurrence than the *Sparrow Hawk*, which is usually the opposite in other parts of the country. Where twenty of the latter are seen, there is not one of the former. Can any of your readers explain this?

The Stone-chat I believe is only a summer visitor to these parts, arriving about the 1st March, and departing again in November. It would be interesting to know in what localities it stays throughout the winter. Probably some of your correspondents on the South Coast will kindly inform us.

The Adder is by no means extinct here. I am frequently informed of single specimens having been seen. A large retriever dog belonging to a friend of mine died last year from the effects of a bite of one of them.

I captured a specimen last spring, in the bogs near Bracebridge Pool; it measured twenty-three inches in length. Old residents inform me that the viper used to literally swarm on the Coldfield about twenty years back.

The Ringed Snake is less frequently seen, though a few occur near Walmley (about three miles from here) in damp situations.

Pine Marten.—A single specimen of this now somewhat rare animal was seen by myself in Upper Nut Hurst last summer. I was only about four feet off when I first saw it asleep in the sunshine on the low branch of an oak. When awakened it darted immediately up the tree and hid itself from view, and although I waited about half-an-hour afterwards, and continued to throw up stones with the hope of seeing it again, I had to turn away disappointed.

The Squirrel is still not uncommon in the less-frequented woods, and any early morning's walk will reveal it to the enquirer. Their nests may be seen any time; the usual situations being in the forket of an oak tree, or at the top of some thick pine or holly. They usually breed in May, and have from three to five young ones at a birth. A nest at the top of a thick holly tree that I found last year contained three young ones,—the prettiest little creatures in creation. The nest measured abont twenty inches in length, and nine or ten inches thick. The outside was composed of the twigs of the pine tree, and the inside lined with the needles of the same; it was oval in shape, and slanting in order to let the rain run off; there were two openings, one at each end, which, however, are always kept closed. When I touched the top the young ones scrambled out and ran down the branches of the tree to the ground, uttering squeaks in doing so. I captured one of them and took it home, and fed it upon bread and milk; it appeared to be very docile, but only survived a few days.

Squirrels seldom become dormant in these parts but remain lively all the winter through. They are amply provided with food, but their numbers seem to be steadily on the decrease.

The Glow-Worm.—Mr. T. B. Grove informs me that he saw one of these insects last summer on a bank in Holly Hurst. I believe this is the first recorded in Sutton Park. Perhaps Mr. Blatch can inform us.

Anodonta anatina.—I have seen great quantities of this shell at a large pool at Langley (2½ miles from Sutton), belonging to a friend of mine. Some of the specimens are of an unusual size.

Birds that nest earliest in these parts:—

Name.	Date.
Rook	February 19th—March 1st.
Redbreast ...	February 29th—March 14th.
Long-eared Owl ...	End of February and beginning of March.
House Sparrow ...	Beginning of March.
Starling	Ditto.
Carrion Crow ...	March 14th—19th.
Hawfinch ...	Middle of March.
Heron	Ditto.
Common Wren ...	Ditto.
Mistletoe Thrush	End of March.
Song Thrush ...	Ditto.
Blackbird...	Ditto.
Hedge Accentor ...	Ditto.
Wild Duck ...	Ditto.
Teal	Ditto.
Lapwing	Ditto.
Snipe	Ditto.
Ringdove... ...	Ditto.
Green Woodpecker	Ditto,
Lesser spotted ditto	Ditto.
Jackdaw	Ditto.

(To be continued.)

METEOROLOGICAL NOTES.—February, 1885.

Barometric pressure was decidedly unsteady this month, and the changes numerous and rapid. The height of the mercurial column was about 29 inches at the commencement of the month; about 30 inches at its close. The weather was generally unsettled. The mean temperature was about 2 degrees above the average, although a short "spell" of frost occurred about the 21st, when the readings were lower than those in February since 1879. The range of temperature was unusually wide. The highest maxima occurred on the 24th, and were—59·2° at Loughborough, 59·0° at Henley-in-Arden, 57·9° at Hodsock, 57·4° at Strelley, and 57·1° at Coston Rectory. In the rays of the sun, 99·1° was registered at Hodsock on the 28th, 97·1° at Loughborough on the 12th, and 93·0° at Strelley on the 28th. The lowest minima were on the 21st, and were 18·8° at Hodsock, 20·3° at Coston Rectory, 21·0° at Loughborough and Henley-in-Arden, and 22·3° at Strelley; 13·3° was registered on the grass at Strelley and

Hodsock, and 15·6° at Loughborough, also on the 21st. Rainfall was slightly above the average, the total values for the month being 3·50 inches at Henley-in-Arden, 2·56 inches at Loughborough, 2·38 inches at Strelley, 2·35 inches at Coston Rectory, and 2·19 inches at Hodsock. The greatest fall occurred on the 16th, and varied from 0·64 to 0·52 of an inch. A little snow fell on two or three days. The prevailing winds were southerly, and occasionally strong in force. Sunshine was again deficient. A lunar halo was observed at Loughborough on the evening of the 27th.

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Natural History Notes.

THE MIDLAND UNION.—The Birmingham Societies are making vigorous preparations for the Annual Meeting of the Union, which is to be held in Birmingham in the middle of June. We trust that all the Societies in the Union will arrange their Meetings so as to leave the days selected (June 16th and 17th) free, and that a large number of their members will take part in the General Meeting, and attend the Soirée and Excursions.

THE AQUARIUM DEPARTMENT will form an attractive feature of the forthcoming Inventions Exhibition. Lord Onslow has lately presented 1,500 exceedingly fine carp; and a large number of fish indigenous to the Canadian Lakes have also been received for exhibition.

THE FAUNA OF WARWICKSHIRE, WORCESTERSHIRE, AND STAFFORDSHIRE.—As I am compiling for publication lists of the Fauna of the above-named three counties, I shall be very much obliged for any assistance that the readers of the "Midland Naturalist" can give me. I am particularly in want of lists of Insecta occurring in the three counties, with their localities and notes on abundance or scarcity, &c. Specialists wishing to contribute will kindly correspond with W. HARCOURT BATH, Sutton Park, near Birmingham.

PROFESSOR HILLHOUSE, it is announced, will shortly publish, through Messrs. Sonnenschein and Co., an English version of Professor Strasburger's "Das Kleine Botanische Practicum," itself an abridgment of a much larger work published in the spring of last year. The book is intended primarily for students and practical workers, and, commencing with the most elementary researches, with the aid of the simplest apparatus only, it is carried up to embryological and other complex work. The volume will be fully illustrated by woodcuts drawn by the author, who is adding fresh notes of most recent information.

A NEW PROTOZOON.—The new chlorophyllogenous protozoon, discovered by Mr. Thomas Bolton, has recently been described by Professor Ray Lankester. He has named it after its discoverer, and after Mr. William Archer, of Dublin (the discoverer of so many Heliozoa), *Archerina Boltoni*. It is simply a sphere of dense protoplasm, with radiating pseudopodia, one or more vacuoles (but none contractile), and a single or bifid chlorophyll corpuscle. It passes through actinophryd, encysted, and vegetative stages. Some may regard it as a case of symbiosis between a moner-like protozoon and a unicellular alga, but Professor Lankester thinks there is no ground for such a supposition.

Origin of the Vertebrata.—The question whether the Vertebrata are derived from a worm-like ancestor or from a nemertine-like form, which gave rise to the Vertebrata on the one hand and the Annelids on the other, has long been of deepest interest to morphologists. Mr. J. T. Cunningham, Director of the Scottish Marine Survey, discusses the subject in the recent issue of the "Quarterly Journal of Microscopical Science," and strongly advocates the theory which regards the Vertebrate as a worm turned on its back. Since in the Worm the œsophagus is embraced by two nerve-cords connecting the brain and ventral nerve-cord, but in the Vertebrate no such arrangement exists, the brain and spinal cord being entirely dorsal to the alimentary canal, the theory requires that a remnant of the original annelid mouth and œsophagus should be found in the vertebrate brain. This remnant Mr. Cunningham finds in the Infundibulum of the brain, which is a deep conical depression on the ventral surface in connection with the Pituitary body, the latter being regarded by Dr. Dohrn as the rudiment of a gill. Mr. Cunningham also regards the notochord as of mesoblastic, and not of hypoblastic origin, as hitherto supposed, and homologous with the three giant fibres beneath the nerve-cord in the earth-worm.

Botanical Research.—A writer in "Nature" (March 19th) gives a few very interesting particulars of the much-increased facilities which are now offered to a student who, having completed his botanical course at our Universities, desires to plunge at once into some original research. Instead of the customary method of visiting Germany, and there sitting at the feet of one of the giants of botanical science whose names have been so familiar to him throughout his University course, he can now avail himself of the opportunity offered at the Botanical Garden at Buitenzcrg, in Java, where, in a not unhealthy locality, he would have all the rich materials of a tropical flora at his command. Dr. Treub, the Director of the Garden, who speaks English, has accommodation in his laboratory for four investigators simultaneously, and the offer is made freely to those of any nation. But even in Europe we have now, besides the well-known station at Naples, a second marine station at Antibes, in the south of France, where, on suitable application, foreigners can obtain admission to the laboratories of the Villa Thuret, and prosecute their researches under the directorship of M. Naudin. The writer also refers to the Jodrell laboratory at Kew, and laments that so little is done by us to utilise in our gardens at Calcutta and Peradeniya opportunities as great as those which the Dutch have at Buitenzorg. There is hope, however, that as regards Britain, the Marine Biological Associations will remove the reproach under which we now labour that there is no station at which an earnest student could prosecute his studies in marine botany, without accepting the help of a foreign Government.

Encouragement of Scientific Research.—The Royal Society of New South Wales offers its medal and a money prize for the best communication (provided it be of sufficient merit) on each of eight subjects of scientific interest. Among these are:—Anatomy and Life-history of the Echidna and Platypus; Anatomy and Life-history of Mollusca peculiar to Australia; Tin Deposits of New South Wales; Iron-ore Deposits of New South Wales; List of Marine Fauna of Port Jackson, with descriptive notes, &c., as to habits, distribution, &c.; Infusoria peculiar to Australia. The competition is open to all the world, without any restriction, excepting that the competition must be either wholly or in part original—mere compilation will not be sufficient.

THE GEOLOGICAL SURVEY.—The year 1883 witnessed the completion of the one inch to a mile geologically-coloured map of England and Wales. Commenced by De La Beche in 1835, the work was continued by Murchison and Ramsay, and has been completed under Geikie. But although the map is nominally completed, much remains to be done. Some of the staff have been transferred to Scotland, but Mr. H. B. Woodward is engaged in Dorsetshire—preparing an important memoir on the Oolite—and others are revising, correcting, or adding to the work previously done in other districts. The fact is, we want (1) a re-survey of the country on the six-inch scale; for we have learnt much since the West of England and Wales was mapped—thirty to fifty years ago—and the old maps are partly obsolete: (2) the preparation of an independent set of drift maps, showing the surface deposits so important to the agriculturist; and (3) the issue of descriptive memoirs which shall treat fully of the nature and contents of the rocks.

THE ORDNANCE SURVEY.—Having completed the map of Scotland, on the scale of six inches to a mile, the officers and sappers of the Royal Engineers have for the last year or two been very busy in the Midland Counties of England. Their poles and marks are conspicuous objects on every hill-top, and already numerous maps of various parts of the district have been issued by the agents—Longmans, Stanford, &c.—for the sale of Government publications. Maps of the whole country on the scale of six inches to a mile, and of towns on the scale of twenty-five inches to a mile, are being executed. The immense value of the six-inch maps to all engaged in scientific pursuits need not be indicated. The detail of these maps is such that they show the outline of every field and the position of every tree. The geologist will, for the first time, be able to lay down accurately on a large scale map the results of his observations, and the archæologist and the botanist will derive equal benefit. It is hoped that the entire Survey will be completed by 1890.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, February 17th. Mr. Wm. Pumphrey, of Bath, displayed a series of photo-micrographs, and read a paper in which he gave a description of the apparatus, and method by which they were produced. He called attention to the great advantage obtained by the use of parallel rays—such parallelism being obtained by causing the light (in this case the light from a powerful paraffin lamp) to traverse two apertures, placed 1½ inches from each other, interposed between the lamp and the object. By this means the intervention of a condensing lens is dispensed with, and a much finer definition attained. Mr. Pumphrey concluded by a display on the screen of a great variety of objects. The selection embraced portions of insects, such as the head appendages of gnats, flies, bees, crickets, &c.; sections of wood, bone, and shell; perfect insects, as *Trombidium*, *Pulex*, *Pediculus*, &c. In order to illustrate the subject more fully, the objects were shown on the screen, in both the positive and negative condition, by which the company were enabled more fully to appreciate the details of the process and the results. It was explained that the lens used was one of Swift's new 40° 1in. objectives, and that the plates were the extra sensitive (XXXXX) of the Paget Plate Company. The reproduction of those parts of the objects in which the natural colour is inactive excited great attention. At the conclusion a lively conversation ensued, in which many of the members present took part.—

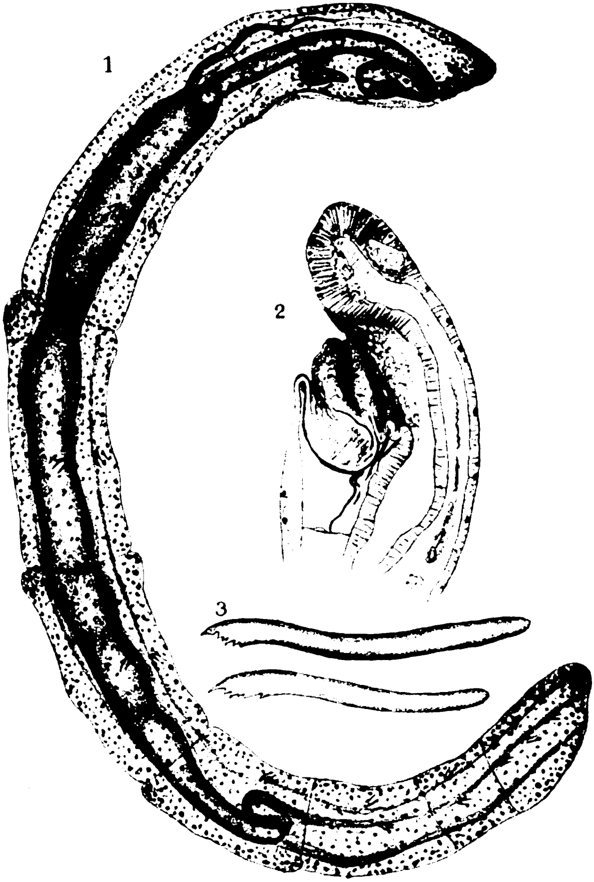
GEOLOGICAL SECTION. February 24th. Mr. T. H. Waller elected Chairman; Mr. John Udall Secretary. Exhibits by Mr. Waller:—1, A case for microscopic slides, by Russell, of Newgate Street, London; 2, a section of one of the old lavas of Ischia. The special point of interest is the disposition of the glass inclusions in one of the sections of leucite. This is radial instead of parallel to the sides of the section. The event of the evening was a paper, by Mr. Marshall, on "Niagara and its Physical and Geological Conditions." The paper was admirably illustrated with maps and diagrams, and brought together a large and appreciative audience.—GENERAL MEETING. March 3rd. Mr. R. W. Chase in the chair. Mr. Lawson Tait presented a number of photographs of diatoms, &c., which he had received from the Government Museum at Washington. The best thanks of the meeting were given to Mr. Tait for the present. Mr. Chase gave some very interesting notes on the esculent swallow (*Collocallia esculenta*). Mr. J. T. Blakemore exhibited the dead bodies of a spider and a beetle which had been in water for some time and had become covered with fungi, supposed to belong to the genus Saprolegnia. Mr. T. Bolton, *Cercariæ*, or tailed larvæ of the fluke, which had escaped from their intermediate hosts the *Limnæa* (water snail). They were seen under the microscope swimming by the vigorous lashing of the tail, and at other times crawling like a leech by the alternate attachment of the suckers, one surrounding the mouth and the other about the centre of the ventral surface. Prof. Hillhouse, a plant of the Hyacinth that had been grown without light; the leaves were white, but the flowers retained their natural colour and odour. He also exhibited a brass rack for holding a number of microscopic slides while they dry. Mr. W. P. Marshall, a singular abnormal growth of a hen's egg containing a second egg. Mr. J. Morley, the horned ichneumon fly (*Eulophus Nemati*), mounted without pressure by Mr. F. Enock.—BIOLOGICAL SECTION. March 10th. Mr. W. P. Marshall in the chair. Mr. Marshall read some interesting notes on the Roraima Mountain in British Guiana, which Mr. Im Thurm ascended in December last, this being the first ascent that has been made. This mountain is 6,000ft. above the sea level and the summit is twelve miles long by four miles wide, and it may be truly described as the garden of orchids. Beside these plants there are also found interesting species belonging to the *Sarraceniaceæ*, or water-pitchers, and the *Utriculariaceæ*, or bladder worts. Prof. Hillhouse illustrated these notes with some excellent models of both these orders, together with the *Nepenthes*, or pitcher plants, and also made some very interesting remarks on the various orders, pointing out their differences and peculiarities. A discussion followed, in which the Chairman, Prof. Hillhouse, and Messrs. France, R. W. Chase, W. H. Wilkinson, and J. E. Bagnall took part. Mr. J. E. Bagnall read some short notes on the uses of mosses, illustrating these by the plants mentioned, and exhibited also a number of mosses from the Nuneaton district; and for Mr. J. B. Stone, *Hypnum cupressiforme*, var. *elatum*, from near Bletchley. Mr. T. Bolton exhibited the larvæ of *Spio seticornis*, with an illustration, and Diatoms with the filaments referred to by Mr. J. Badcock in his paper in the "Journal of the R. M. S.," July, 1884. Mr. R. W. Chase, *Somateria mollissima*, the Eider Duck, showing the various stages from the young to the adult in both male and female; he also gave some extremely interesting notes on the habits and life history of these birds. Mr. W. H. Wilkinson also exhibited a number of lichens from near Crieff, Scotland, calling special attention to the following:—*Parmelia conspersa*, *Physcia speciosa*, *Cladonia squamosa*, and *Collema nigrescens*; also *Physcia stellaris*, var. *actinota*, from Blockley.—MICROSCOPICAL SECTION. March 17th. Mr. W. H. Wilkinson exhibited a specimen of the pretty white-flowered Allium from France, sold in shops as the "Star of Bethlehem," in which the central axis was continued upwards through the umbel, then forming a second and smaller umbel of flowers above. He also exhibited an abnormal orange, which Professor Hillhouse explained was a double orange, viz., a second orange, with carpels and rind quite complete, growing inside the other. Mr. C. Pumphrey then exhibited, by the aid of the lime-light lantern, the second series of photographs taken by him during his late visit to America. After showing maps and plans of the district visited, he threw upon the screen a large number of beautiful views, comprising scenes in Quebec, the Falls of Montmorency, Chicago, the steam engines with their peculiar chimneys (spark catchers), the style of carriages used, the railway lines and bridges; also views on the St. Lawrence and Hudson Rivers, showing the tall steamboats used there; views of Lake George, and a very interesting series of pictures of Niagara Falls, showing the grandeur of the falling mass of water from many different points of vantage. The display was much appreciated, and complimentary remarks were made by the chairman, Mr. R. W. Chase, and Mr. W. P. Marshall; and a hearty vote of thanks to Mr. Pumphrey was passed unanimously. —SOCIOLOGICAL SECTION. March 5th. Mr. W. H. France read the second chapter of Mr. Herbert Spencer's "Study of Sociology," and the reading was followed by an interesting discussion.—At a meeting of the Section held on Thursday, March 19th, Chapters 6 and 7 of Part III. of Mr. Spencer's "Principles of Biology" were considered, the discussion being introduced in a paper by Dr. Hiepe.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 23rd. Mr. J. W. Neville exhibited twelve botanical sections, double stained, prepared by Mr. G. Wilkes, of Manchester; Mr. Bradbury, a collection of butterflies, from the Malay Archipelago. Under the microscope, Mr. Hawkes showed cirrhi of barnacle (*Balanus balanoides*); also ova of the same and young in the first stage.—March 2nd. Mr. T. H. Waller, B.A., B.Sc., delivered a lecture on "The Microscopic Structure of Rowley Rag," which was largely illustrated by specimens and sections under the microscopes.—March 9th. Mr. Moore exhibited specimens of the slug *Testacella haliotoidea*, from Chiswick; Mr. Tylar, a fossil Echinus, in Lias clay, with spines *in situ*; Mr. Insley, a collection of ferns, grasses, &c., made in Afghanistan and the district. Under the microscope Mr. Tylar showed larva of *Corethra plumicornis*, pierced with threads of hydra; Mr. J. W. Neville, mouth organs of wasp, mounted without pressure, and explained the mode of its preparation.—March 16th. Mr. Wykes showed stems of *Lepidodendron* in true coal. The following objects were exhibited under the microscopes:—Mr. Dunn, pulsations of the heart in *Planorbis vortex*; Mr. Tylar, anchor plates of *Synapta inhærens* and *S. digitata*; Mr. Foster, parasite of Red-throated Diver (*Colymbus septentrionalis*); Mr. Moore, alimentary canal of *Agrion pulchellum*. A paper was then read by Mr. A. Foster on "Some common objects of the microscope," which described the educational advantages to be derived from microscopic observations. The minute structure of entomological, botanical, and anatomical objects was described, and the additions made by the microscope to our knowledge of the structural peculiarities of the objects by which we are surrounded. The paper was largely illustrated by microscopic slides.

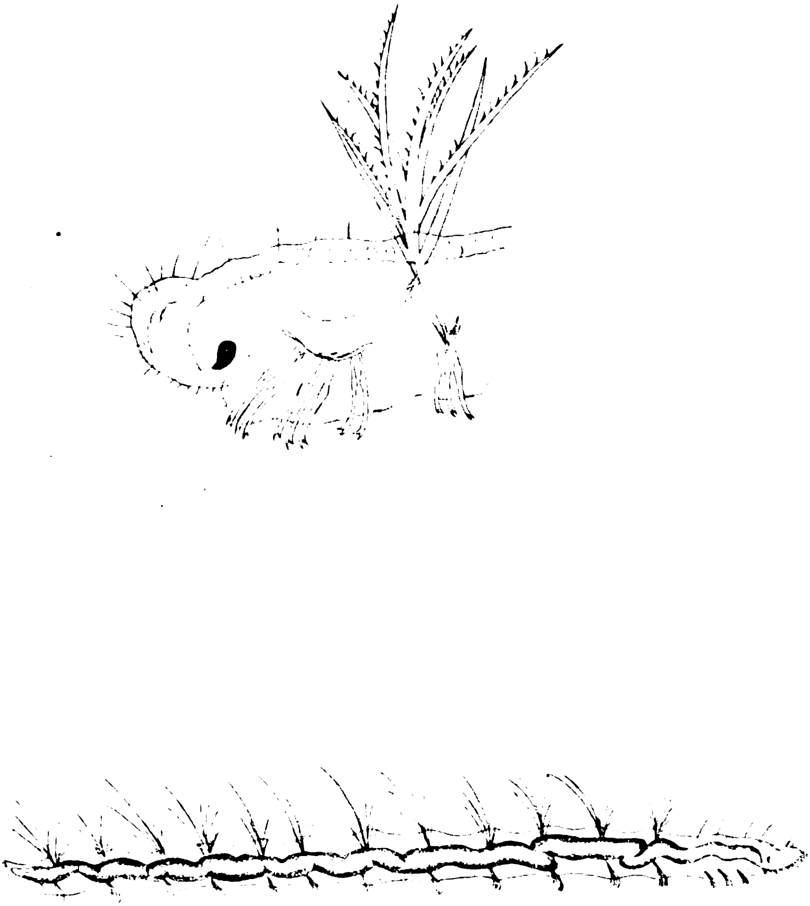
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D.—ZOOLOGY AND BOTANY.—Chairman: F. T. Mott, F.R.G.S. MONTHLY MEETING, March 18th. Exhibits: The Text-book of Zoology, by Claus, translated by Sedgwick; "Notes Algologiques," by Bornet and Thuret; Microscopic slides of *Lyngbya*, *Ulothrix*, *Draparnaldia*, and other algæ, by Mr. F. Bates. A box of marine shells, *Trochi neritæ*, &c., by Miss Adderly. A gathering of mosses from Leicestershire, and another from Hampshire, by Miss Grundy. Four dead freshwater shells taken from the underside of a small piece of *Marchantia polymorpha*, growing on a stone in Bradgate Brook, viz., *Valvata piscinalis*, *Planorbis albus*, *Pisidium pulchellum*, and a very small *Linnæus*, only a quarter of an inch long, probably the young of *Stagnalis*; also a curious small Hepatic, not yet identified, by the Chairman. Specimens of *Erophila vulgaris* (*Draba nerna*) in flower, only three-quarters of an inch high, by Mr. Quilter. Papers (1) "On Heterostylism," by Mr. E. F. Cooper, F.L.S., describing the dimorphic flowers of *Primula vulgaris*, and the trimorphic flowers of *Lythrum salicaria*, and showing how the latter is probably approaching to a diœcious condition. The paper was illustrated by specimens and drawings. (2) "On a wild bee's nest," by Mr. Thomas Carter, LL.B., describing and exhibiting the clay cells, with cocoons, and pellets of pollen found in the interior of a door lock, which two bees were observed frequently to visit. Also several cells from an inch to an inch-and-a-half long, composed entirely of portions of leaves found in another corner of the same lock. A bee was also exhibited which was believed to be one of those seen visiting the lock, and which appeared to be a species of *Osmia*. (3) "On a possible origin of organic life," by the Chairman, suggesting that as the most fundamental difference between organic and inorganic objects was the greater concentration of energy in the former, the differentiation may have occurred when the concentrating energy which produced this earth from nebulous matter was at its maximum; that as that period is long past, the conditions necessary for such differentiation do not now exist, so that no change from inorganic to organic is now possible, except under the law of biogenesis. It was arranged to take the first field day of the season on April 8th, to Kirby Muxloe Castle.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—February 19th.—Exhibits:—Mr. A. Gee, various foraminifera and diatoms, including *Isthmia nervosa* in situ; Mr. A. W. Beale, various diatoms, crystals of gold quartz and peacock copper, and the water flea, *Daphnia pulex*; Mr. J. W. Bodger, unripe and ripe capsules of *Tortula muralis*, showing peristome and spores. Miss Perkins exhibited a collection of local mosses, made by the Marchioness Dowager of Huntly, and kindly lent for the occasion. Mr. J. W. Bodger exhibited and presented to the Society, *Balanus tintinnabulum* from the Coromandel coast, *Balanus spinosus* from Ceylon, and *Neritina viridis* from Barbadoes. Dr. W. Easby presented to the Society an apprentice's indenture dated 1714; a Sudbury token, 1793; a Chatteris token, 1813; a March silver token, 1811. Mr. W. Heath presented a cuckoo, *Cuculus canorus*; starling, *Sturnus vulgaris*; skylark, *Alauda arvensis*; chaffinch, *Fringilla cœlebs*; yellow hammer, *Emberiza citrinella*; royston or hooded crow, *Corvus cornix*. Mr. W. Doughty, a barn owl, *Strix flammea*. Mr. G. Thompson, a common gull, *Larus canus*. Mr. W. Heath, jun., a little grebe, *Podiceps minor*. Mr. A. W. Nicholls exhibited *Gnaphalium leontopodium* from the Alps, and *G. uliginosum* from Fletton. Mr. J. Perkins exhibited *Neritina fluviatilis* from River Lane.

Plate IV



CTENODRILUS PARDALIS



NAIS HAMATA

NOTES ON TWO RARE ANNELIDS.*

BY T. BOLTON, F.R.M.S.

CTENODRILUS PARDALIS.

This interesting little annelid turned up for a short time in abundance in one of the marine aquaria in my studio. It is impossible to say what its source may have been, as I have added organisms to my aquarium from the south-west, and north-east coasts of England, and also from North Wales.

It was described in 1863, by Edward Claparède, from a single immature specimen which he had found two years before near St. Vaast la Hougue, on the coast of Normandy, nearly opposite the Isle of Wight, and was named by him *Ctenodrilus pardalis*, nov. gen. et sp. Professor E. Ray Lankester considers that the same animal was described in 1857 by Oscar Schmidt under the name of *Parthenope serrata*. Dr. J. Kennel gives a long report on this annelid in the Arbeiten Zool. Zoot. Inst. in Wurzburg, 1882, as a contribution to the knowledge of the anatomy and gemmation of annelids. He had the opportunity, in 1879, of examining it very carefully in the Zoological Station of Naples, where it appeared in great abundance in the diatomacean slime on the surface of the tanks in the aquarium.

He gives the following as the characteristics of the genus and species :—

"Fam. *Ctenodrilidæ:* Small marine annelids, consisting of few segments, bundles of bristles on each side bilateral, bristles pectinate at the point, blood-vessel system not closed, dorsal vessel is only in the first body-segments, and opens into the ventral cavity in the first abdominal-segment. A single pair of segmental organs in the head. Continuous multiplication by subdivision in combination with budding-processes. Sexual reproduction unknown.

"*Ctenodrilus:* 12—15 segments, head consisting of two or three segments, mouth with a strong evertible underlip; in the dorsal blood-vessel a string-like organ of doubtful

*Exhibited before the Birmingham Natural History Society, on November 18th and December 9th, 1884.

signification. Budding-zones in the abdominal region between every two segments. The whole nerve system in the epidermis.

" *C. pardalis:* Clap. Intestine, dark brown; in the skin numerous green drops. Amongst algæ and diatoms."

NAIS HAMATA.

This annelid, which is new to Great Britain, I found lately amongst a quantity of desmids and diatoms in a shallow ditch in Sutton Park, and I have more recently found associated with it *Nais lurida.* Both these were first discovered in Lower Franconia by R. Timm, and were figured and described by him in the Arbeiten Zool. Zoot. Inst. in Wurzburg, 1883. He describes the *Nais hamata* as follows:—

"The number of segments varies in a single individual between 20 and 30; body colourless, pellucid. Ventral bristles fine, generally two or three together. Dorsal bristles, begin in the fourth segment, reaching nearly three times as long as the thickness of the body, arched like a scimitar, furnished on the convex side with fine barbs, which are at least as long as the bristle is thick. In every bundle there are four to seven long and one to three shorter bristles. Tactile bristles (especially on the head), somewhat abundant. Brain not so distinctly divided into two lobes as in the other Naidina. Alimentary canal proportionately very large, with unusually strong, not interrupted, cell-layer. Muscular system extremely minute; whether a ring muscular layer is present, I cannot say; for the rest, it resembles that of the other Naidina. Both the blood-vessels have a considerable volume; their transverse section is mostly greater than that of the alimentary canal. I have only been able to see vessel-loops in the head segments, but it must not be understood that they are wanting in the remaining segments. Intestinal net distinct. The eyes, whose occurrence generally in the Naidina is very variable, are not always present. The extraordinarily thin epidermis thickens itself in the head and tail considerably, so that at both ends it forms a kind of cap. Length of each single animal, three to five mm.

"I have only found a few examples of this species in the act of budding, and then the zooids always holding together only in twos. Of these, the second was universally richer in segments than the first, while in the two-jointed chains of *Nais elinguis* I generally found the reverse condition."

THE EAR AND HEARING.*

BY W. J. ABEL, B.A., F.R.M.S.

Sound may be described as the vibration of solids and fluids, propagated, by means of waves, through some intervening medium, to a specially prepared sentient surface. The function of the ear is to intercept and collect these undulations, and convey the result to the brain, by which organ they are made manifest to the individual as sound sensations. We may thus define the sensation of hearing as the conscious state resulting from the impinging, upon a specially prepared part of the sentient surface of the body, of aërial or other fluid vibrations, caused by the molecular disturbance of bodies in a state of tremor or vibration. Thus, in hearing, as in the other sensations, we take cognisance by the mind, not of the sonorous object, but of the condition of the auditory nerve; and all the ideas we form of sounds, as to their nature, intensity, direction, &c., must be based upon the changes which they produce in it.

The essential part of an organ of hearing is obviously a nerve endowed with the peculiar property of receiving and transmitting sonorous undulations.

Since all matter is capable of propagating sonorous vibrations, the simplest conditions must be sufficient for mere hearing, as all substances surrounding the auditory nerve can communicate sound vibrations to it. In the eye a certain disposition of parts is essential to cause the rays of light to impinge on the sentient surface with the same relative disposition as that which they held when they left the visible object; but in the ear, whenever and however sonorous undulations affect the nerve, they must cause a sensation of sound. It is, therefore, by no means indispensable, as some assert, that any specially modified surface should be included in the auditory apparatus, since the auditory nerve if merely in contact with any solid part—as the head—will be affected by the vibrations in which it is continually participating; and we are thus unable to assert that the sense is present only where we can discover a special organ.

The two modifications most constantly present in all auditory organs hitherto identified are—

I. A cavity wholly or partially filled with fluid, and lined with a membrane on which the nerve is distributed.

* Read before the Nottingham Naturalists' Society, February 17, 1885.

II. A solid body, or bodies, of greater specific gravity than the surrounding substance.

The whole course of the development of the ear will be found to consist in a progressive series of adaptations for rendering more perfect the propagation of the sonorous vibrations, for their multiplication by resonance, and their more delicate discrimination.

The simplest form of ear hitherto identified is found in aquatic animals. It is marked only by the first of the two modifications noted above, and seems capable of receiving sonorous vibrations but imperfectly, and quite incapable of resolving them into tones. The next advance is marked by the addition of the second of the above modifications, thereby increasing the sensibility to vibratory influence. A still greater advance is the suspension of the whole sac in a more liquid material (the perilymph), followed successively by the evolution of an aperture, covered by a membrane upon which the external medium can at once act—the differentiation of the appendages of the vestibule, the cochlea, and, lastly, by the appearance of an external ear.

The lowest forms in which I am aware of the discovery of an ear are the *Medusidæ*, amongst the Coelenterates. In the edge of the umbrella of the common jelly fish (*Rhizostoma Pulmo*), the microscope, with a half-inch objective, shows small vesicles at the bases of the tentacles. In each of these vesicles may be seen a minute body, closely resembling a bell-clapper, suspended by a ligamentous neck, and vibrating about one hundred times a minute. These oval cells are thought to be the ears of the creature, and the solid particles contained in them to be otoliths (ear stones). In the next group—*Echinozoa*—I am not aware of the discovery of any auditory apparatus, although a true nervous system is present in the higher forms, amongst which eye spots are found (*e.g.*, some of the Entozoa and Rotifera).

Coming to the next sub-kingdom—*Annulosa*— we find that, although the sense of hearing in insects seems evident, little is known about their auditory apparatus. Ramdohr has placed it in the jaws, Strauss and Durckheim in the antennæ, De Blainville in the tracheal tubes on the sides of the body, and Agassiz in the legs. Professor von Graber finds what he terms "chordotonal sense organs" in the rod-like secretory structures of the nerves of various parts (chiefly legs or wings) of insects. He states that the general type of rod is pencil-like (scolopal), being pointed at its proximal end, and hollow, with extremely refractive walls. In some genera these rods are fastened to the integument by a special ligament, consisting of a thin-walled tube, continuous with the sheath of the nerve, and filled with a homogeneous and slightly granular mass. From an examination of upwards of sixty genera he gives as the most usual seat of the organ, the hind rudimentary wings (halteres) amongst the Diptera, next the fore wings, and, in the lower orders, the legs. He considers that in the Gryllidæ (grasshoppers) the tympanum and auditory meatus are both represented—the latter by the tracheal tubes, and the former by a peculiar enlargement of the trachea—whilst he identifies the above noted scolopophorous and other chordotonal nerve-endings with the organ of Corti (of which we shall treat shortly), and holds that the perception of auditory sensations is shared with the brain and head, by part of the ventral ganglia.

In the class *Arachnida*, exemplified by mites, spiders, and scorpions, F. Dahl considers that he has established, by experiment, the existence of a sense of hearing, which he localises in two kinds of hairs found on the legs and palps of these arthropods—(*a*) a hair of equal thickness throughout, fringed with a short pile near the apex, implanted in a cup-like depression, extremely mobile, and connected with a nerve at its base; and (*b*) a hair set in rows, and projecting outwards more than the ordinary protective hairs.

Some of the hairs on the claw-joints of scorpions are said by Dahl to have a like function; and the pits found by Haller in ticks (Ixodes) may possibly come under the same category.

Amongst the *Crustaceans* (cyclops, shrimps, lobsters, &c.), the ear consists of a small cavity excavated in the solid framework of the head. It may be easily found in the lobster or crayfish by examining the bases of the smaller antennæ (antennulæ). It is a little prominence of very hard shell, having a circular opening at the apex, across which is placed a thin membrane. Inside this is a sac filled with liquid, having the auditory nerve distributed over its inner surface, and containing one or more small bodies called otoliths.

Siebold was the first to notice the organs of hearing in the next sub-kingdom of invertebrates—the *Mollusca*. In the Lamellibranchiates (including mussels, oysters, cockles. &c.), they are situated in the foot, and consist of a large central ganglion, on each side of which is a minute cavity filled with the usual endolymph, and enclosing a small otolith. This otolith may be conveniently seen oscillating rapidly in the foot of the Cyclas, by using a half-inch objective.

In the Gastropods (snail, whelk, &c.), the ear is at the base of the tentacles. It consists of an auditory sac containing otoliths, which vary with the species.

In the Cephalopods (sepia, cuttle, nautilus, &c.), the auditory sac is situated in the nervous ganglia at the base of the head. The first approach to a labyrinth makes its appearance in this class.

Ascending to the sub-kingdom, *Vertebrata*, we find the organ but little more complicated in the lowest order of fishes.

In the Cyclostome (round-mouthed sucker fishes, as the hag fish), the vestibule, represented by the sac amongst invertebrates, gives off a single annular passage, which may be considered as a semicircular canal, containing a few twigs of the auditory nerve. Amongst the higher Cyclostomes—as the lamprey—two such canals exist, whilst all other fish have three holding the same relation to each other as they do in man.

In the higher orders of fish, as just noted, we find the important addition of the labyrinth, consisting of three semicircular canals communicating with the vestibule, which, with the two ampullæ, formed by the expansion of the semicircular canals, give rise to three cavities at each side of the base of the brain. In each of these cavities is suspended an otolith, enclosed by the gelatinous endolymph, and enveloped by a thin membrane traversed in every direction by minute branches of the auditory nerve, forming an exquisite suspensory ligament. These otoliths are best studied in the skate, herring, sprat, mackerel, or salmon. They are calcareous concretions, pulverulent in the cartilaginous fishes (as the shark and ray), but hard and stony, and of a porcellanous appearance, in the osseous tribes.

Some rudiment of a tympanic cavity may be found in fishes, but there is no trace of a cochlea. In several of the species there is a connection between the labyrinth and the air bladder, made by a chain of bones, appearing to foreshadow the eustachian tube of the higher vertebrates. In the loach the air bladder is exceedingly small, extending under only two vertebræ, and is united with the head in this way. The skate has rudimentary external ears on the top of its head.

In the *Amphibia* (proteus, newt, frog, &c.), which are in many respects intermediate between the true reptiles and fishes, some species have a tympanum, whilst others, like fish, are destitute of it. Wherever the tympanum is distinct, there is also an eustachian tube connecting it with the fauces (top of throat).

The true Reptiles (turtles, snakes, lizards, and crocodiles) possess constantly a tympanic membrane and cavity containing a chain of bones. A rudimentary cochlea is also found (exemplified in the frog), not coiled as in mammals, but only slightly bent. There is, however, in the aquatic forms no external orifice, for, were the membrane exposed, as in mammals, sounds would be intolerable to the animals when in water. Abbé Nollet performed many experiments to prove this, which he reasoned should be owing to water being a better conductor of sonorous vibrations than air. Amongst other experiments, he struck together two pieces of metal or stone, whilst totally immersed in water, and found that the resulting sound sensations were painfully intense. Hence the drum in this class is completely covered with skin, and its position is only marked by a slight circular depression behind and a little below each eye. In these animals the otoliths appear to change their character. The stapeolus (the smallest of the three otoliths found on either side of the head of fish) here elongates into a trumpet-like body—the columella—whilst the other two otoliths on each side are much diminished, and become partly embedded in the fibres of the tympanic membrane. The expanded part of the columella forms a kind of disc closing the fenestra ovalis, which, like the fenestra rotunda, is found in the vestibule of reptiles.

Amongst Birds (*Aves*) the structure of the ear is essentially the same as in the higher reptiles. In birds, however, we notice a small external orifice, and, in some of the owl tribe, a rudimentary concha, or external ear. A distinct cochlea exists, resembling that in reptiles. It is divided into two passages by a membranous partition, on which the nerve is spread out. The tympanum, also, communicates with cavities in the cranial bones, which are thus filled with air, and, by increasing the extent of surface, would seem to produce a more powerful resonance.

(To be continued.)

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

(Continued from page 97.)

The accompanying map (see Plate II.) shows the outcrop of the Marlstone Rock in the Leicestershire district. It is based on the lines of the Government Geological Survey, and is on the scale of $\frac{5}{28}$ of an inch to the mile. We may, I believe, take it as approximately correct, if not absolutely accurate, at every point. It must not, however, be imagined that this map gives a true idea of the area where the Rock-bed may be profitably worked for iron. In two distinct ways the Marlstone area shown on the map is very much larger, and in one way it is a little smaller, than the productive ironstone area met with in the field. In the first place the Marlstone Rock is, over a large portion of the district (namely, in the whole of the Rutland area, also south of Tilton and north of Caythorpe), *too thin* to work. In other places where it normally possesses a workable thickness, the whole or a large part of the upper or iron-bearing beds have been removed by denudation so that only the lower or unproductive arenaceous beds remain. This will be the case more particularly on the hill slopes. In some cases, too, the Marlstone may be covered with a thicker capping of boulder clay than it would pay to remove. For these reasons the Marlstone area is larger than the Ironstone area. On the other hand, where the prevailing dip carries the Marlstone Rock under newer formations, the ironstone, when present, may be followed for a short distance, until the "head" becomes too great and the rock gets too calcareous for profitable working. In these places, then, the Marlstone area delineated on the map may be somewhat smaller than the available Ironstone area. It should also be borne in mind that in the productive region the ironstone varies considerably in quality, its richness increasing apparently in proportion to the amount of atmospheric disintegration it has undergone, and the greater completeness with which oxidation of the iron carbonate and removal of the calcic carbonate have in consequence been carried.

After making all due allowance for the above causes of limitation and deterioration we cannot but be impressed with the vastness of the stores of iron which must be contained in this field. When we remember that the workable ironstone averages seven feet in thickness and covers many square miles of country, and that every acre yields 2,000 tons of ore per foot thick (or a total, say, of 12,000 tons of ore and 4,000 tons of metallic iron per acre), we see what an immense amount of mineral wealth is contained in the Marlstone Rock of the Leicestershire district. The proximity of this stone to a coalfield, viz., the Notts-Derbyshire, is also greatly in its favour, and enables this Lias ironstone to successfully compete with the somewhat richer but more distant Northamptonshire ore. It is impossible to do more than give a rough estimate of the total annual output of the Marlstone ore in the Leicestershire district. No complete mineral statistics are published for this field, and if there were they would not be reliable, seeing that new workings are constantly being opened out.

At the present time there are four principal workings, viz., Holwell, Woolsthorpe, Eastwell, and Wartnaby, which each raise between 400 and 600 tons of ore daily, and four smaller ones, viz., Caythorpe, Tilton, Eaton, and Swaine's Lodge, which each get between 200 and 300 tons daily. This would make for the whole district a total of about 3,000 tons per diem, or 15,000 tons per week of five working days, and for the year, therefore, no less than 750,000 tons. The above estimate must not, however, be considered as anything more than a rough approximation of the truth, and is also liable to correction, as the output from some of the smaller workings is increased, and as new workings are from time to time opened out. There is an immediate prospect of such new workings, both on the Eastwell branch and on the extended Woolsthorpe branch, as well as at one or two other places in the district. In the course of the next two or three years the total annual output of iron ore in the Leicestershire district will, in all probability, exceed rather than fall short of a million tons.

The general method followed in working the ironstone is to drive a cutting for a considerable distance—from an eighth to half a mile—in a straight line, and to work along either one or both faces of the cutting. The soil, with the earthy débris of the top rubble, which is generally sifted out by using quarry-forks, is strewn over the rock-surface laid bare by the quarrying operations. The land thus restored is equal, and indeed superior, to what it was before the ironstone was removed, the shaking together of the particles of the somewhat too loose surface soil, and the addition thereto of the earthy débris of the underlying rubble, having a decidedly beneficial effect. We may frequently see good crops of corn or grass growing on the made-ground to within a few feet of the present working face. These ironstone workings do not then permanently injure, but rather improve the property of the fortunate landowners of the district.

The state of combination of the iron in the Marlstone ore is that of the hydrated oxide, or the same as in the very similar Northamptonshire ore of Oolitic age. It differs from that ore, however, in being essentially a calcareous instead of a siliceous stone. The Marlstone ore contains on an average from 30 to 33 per cent. of metallic iron. This percentage, though somewhat less than that of the Northamptonshire ore, is equal to the average percentage of the celebrated Cleveland ironstone, and distinctly superior to that of the Marlstone of Oxfordshire. The metal extracted from the marlstone of Leicestershire is said to be superior in quality to that obtained from the Northamptonshire ironstone.

It is, however, found advantageous to mix a certain amount of the Northamptonshire stone with the Marlstone ore. The flux in general use is Derbyshire Limestone. Notwithstanding the large amount of water present, it is not usual to calcine the stone before putting it into the furnace. So far as the experiment has been at present tried, it is found that calcination, though it lessens the cost of manufacture, depreciates the quality of the metal, the furnaces tending to work hotter and make a more siliceous iron, which is not so highly valued in the market. For the purpose of comparison, I append a couple of analyses of the Marlstone ores of Leicestershire, the Cleveland district, and Oxfordshire, which may be taken as fairly representative of the quality of the stone in each instance. In reference to the Eastwell and Holwell ores, however, I wish to say that these analyses must not be taken as giving the relative richness of the ironstone at those two places, or, indeed, anything more than a rough idea of their general composition. The Marlstone ore varies so much in different beds, and in the same beds in short distances, that no two analyses, even in the same bed in the same quarry, would correspond. Hence, it is impossible from one or two analyses to determine the average percentage of this ironstone anywhere.

When unweathered, the Leicestershire Marlstone is very similar in appearance and has a very similar composition to the Cleveland ironstone, being a fine grained oolitic rock of a bluish-green colour, and containing the iron in the state of a carbonate. It also belongs to the same geological horizon (Middle Lias), and the two rocks may, therefore, be considered as approximately synchronous. In order to ascertain whether the percentage of iron in the unweathered marlstone of Leicestershire was such as to render it workable or otherwise, I have had two analyses of the Tilton stone made for me by Mr. G. F. Downar, analytical chemist, Bestwood, Notts. These analyses show that iron is present in the upper beds of the unweathered Marlstone Rock to the extent of from 25 to 30 per cent.—a percentage quite equal to that of certain beds which have been profitably worked in Cleveland and elsewhere, and falling but little short of the average percentage of the weathered marlstone ore of Leicestershire. It is not, however, to be supposed that it would pay to mine the unweathered ironstone in a district where the weathered rock covers many square miles of country, is of about equal thickness, has a better percentage of iron, and, being a much softer stone, and lying at the surface of the ground, and at a good altitude too, can be much more economically worked.

A point of some interest that arises out of the consideration of the mineral character of the Marlstone Rock is the question of its coloration. Originally grey or greenish-blue, this rock becomes, when exposed to the prolonged action of the air (or of water containing oxygen), of a rusty brown colour; coincidently with this change in colour, the carbonate of iron becomes converted into the hydrated ferric oxide. There appears to be good deal of doubt as to what gives the grey tint to the unweathered stone. Dr. Sorby, with many others, supposes that the (bluish) green colour in this class of rocks is due to the presence of glauconite—an earthy mineral, having the composition of silicate of iron with some magnesia and water, and that the blue colour is given by the phosphate of iron. Prof. Judd, following Ebelman, holds that the blue colour in many oolitic limestones is due to a small quantity of sulphide of iron distributed through the rock mass, and ascribes the grey tint of the unweathered Northamptonshire ironstone, and therefore, also of the Leicestershire marlstone, to this substance. The green colour he ascribes to either the silicate or the phosphate of iron. The bisulphide of iron is certainly present in small quantity in the Tilton stone, but it seems rather difficult to understand how this material could give a blue colour to the rock. A small amount of the silicate of iron is present in the rock, and perhaps also a little phosphate of iron. The simplest explanation would be to ascribe the original grey colour of the marlstone to the carbonate of iron, a material which, as a chemical salt, is white, but becomes grey on exposure, or possibly to this and the phosphate of iron which gives a more pronounced grey tint. The green colour of the partially weathered marlstone may, I believe, be looked upon rather as a transitional stage from the blue to the brown stone, than as an original tint. I consider that it may be explained by the formation, in gradually increasing quantities, during exposure, of particles of the yellow hydrated ferric oxide, disseminated through the unaltered grey particles of the rock, just as by mixing blue and yellow pigments together we get a green tint.

(To be continued.)

Rats.—A gentleman saw repeatedly the singular spectacle of three rats running abreast over his grounds. Noting their track, and their usual times, he shot them, and then found that the middle rat was blind, and that all three held a straw in their mouths. It is almost too good to be true.—"Reminiscences," by Rev. T. Mozley, M.A. Vol. I., p. 115. (London: Longmans, 1885.)

THE PRINCIPLES OF BIOLOGY.
BY HERBERT SPENCER.

Exposition of Chapter X.—Genesis, Heredity, and Variation.
BY W. B. GROVE, B.A.

This chapter is devoted to the final elaboration of the grand doctrine of physiological units (the plastides of some authors), by which Herbert Spencer tries to dissipate in some degree the mysterious phenomena of Genesis. We may make the preliminary remark that the mystery is, and cannot be, nay, is not intended to be, completely dissipated; the hypothesis only lends definiteness to our conceptions, and enables us to picture faintly to ourselves the mode of action. In this respect it resembles that other great doctrine of which it is an extension, the atomic theory itself; for after all we do not know (perhaps may never know) that atoms really exist; they are only mental representatives of something which does exist, and which, whatever its nature, obeys the same laws of combination and action which we feign for the atoms. It amounts to this—that Herbert Spencer's theory is true in fact, if not in form. It reduces the phenomena that we have been considering into their places in that vast reign of order, the slow, but sure, establishment of which is the object of scientific aims.

These phenomena may be represented in a formula:—

Genesis = Homogenesis (Gamog.) + Heterog. (Gamog. + Agamog.)

and we have discovered that the latter part of the formula, agamogenesis interrupted by more or less frequently recurring gamogenesis, represents the more normal and frequent state of things. The question, when gamogenesis recurs, has been already answered; but why? Let us consider the facts from the beginning.

We suppose matter to be built up of atoms, which, by their combinations, give rise to molecules. These molecules are of gradually increasing complexity. We have the crystalloids, composed of few atoms, and comparatively stable; and the colloids, composed of many atoms, and comparatively unstable. The modern chemist is familiar with molecules consisting of hundreds of atoms, and we have no reason for supposing the process to end there. We may reasonably imagine these colloidal molecules to unite in molecules of a still higher order: these are the physiological units. It is known that as the number of unlike, but allied, atoms comprising the molecule increases, so in general does its instability, its susceptibility to external forces, and the number of its kinds. Illustrations are found in the fusible metals, which melt at a lower temperature than their constituents.

It is established in "First Principles" that any aggregate of molecules tends always towards equilibrium, and change cannot cease till equilibrium is reached. The aggregate acts upon the molecules in such a way as to cause them to tend towards certain positions; it is to this tendency that we apply the much-abused word "polarity." Its effect is seen in the growth of a crystal and the annealing of glass. If we imagine an aggregate of molecules of iron, for instance, unacted upon by external forces, they would exhibit a tendency, supposing them free to move, to place themselves all "heads and tails"; and we see instances of an approach to this state in the sometimes disastrous change which a wrought-iron bridge suffers when subject to continuous jar, and in the magnetisation of a bar of iron by hammering it while placed parallel to the terrestrial magnetic axis.

Now in the case of a growing organism we know how much greater and more rapid the changes are at first; the rate of change gradually diminishes, life becomes less active, the state of equilibrium draws nearer and nearer, and finally, when the molecules of the organism in certain parts cease to react to the stimulus of external forces, life has ceased, the organism is dead. The degree of activity of life is proportional to the susceptibility of the organic molecules, *i.e.*, the physiological units, to the action of the environment. "When therefore we see," as we have seen, "that gamogenesis recurs only when growth is decreasing or has come to an end, we must say that it recurs only when the organic units are approximating to equilibrium—only when their mutual restraints prevent them from readily changing their arrangements in obedience to incident forces."

We deduce then this result, that the use of gamogenesis lies in the necessity of overcoming this tendency to equilibrium and re-establishing the capacity for active molecular change, "a result which is effected by mixing the slightly-different physiological units of slightly-different individuals." The cells which unite have severally nearly reached a condition of equilibrium; this is shown by the fact that, if ununited, they are capable of only a little further growth. But though they are individually *in equilibrio*, yet, as they are derived from more or less unlike parts, the product of their union is not so; in fact, the slight unlikeness which exists is, as is known from inorganic chemistry, the very condition which ensures great instability, *i.e.*, in this case, great capacity for growth, in the product. Too great a difference is as ineffective as too little.

We know from the instance of Begonia that a single cell can contain within itself all the physiological units necessary for the reproduction of a species. Assuming then that the fertilised germ contains all the required units—derived jointly from both parents, and in a state suited for further growth—let us test the hypothesis by comparing it with established facts.

In the first place, Heredity and Variation become mere matters of course. The offspring cannot but resemble at the same time that it differs from its parents. Then the superiority of cross fertilisation to self-fertilisation is manifest in the greater unlikeness between the combining units which it ensures, and the consequent greater vitality of the offspring. Upon these, which are so fully treated in the original, it is not necessary to enlarge. Though self-fertilisation is not impossible, yet it is probable that it could not go on for ever; the species would in most cases die out. *A fortiori*, then agamogenesis could not go on for ever; yet as we have seen before, so far as our present knowledge extends, there seem to be cases in which no gamogenesis ever occurs. The cases of plants propagated, as it would appear, indefinitely by buds or cuttings or offsets, *e.g.*, the prolific banana, in which it is said no seeds have ever been produced within historic times, as well as those extremely numerous cases of fungi which were mentioned in a previous chapter, all show that the theory so far presented, though true, is not the whole truth.

We find agamogenesis prevailing the more the lower the type of the organism, the less differentiated its parts, the simpler and more uniform the conditions under which it lives; and this view is confirmed by observing that the only large class of plants in which no gamogenesis is known in any of its members is the lowest of all, the Bacteria. Hence it is obvious that the need for gamogenesis increases in proportion to the complexity of the forces which act upon the organism. Now, what causes a species to continue to live? Its fitness for its environment. If then this fitness can be easily maintained on the average, if the species exhibits no great tendency to vary in such a way as to unfit itself for its conditions of life, if in fact the forces which act upon it are not relatively complex, then it can maintain its position for long periods even by agamogenesis; but if the conditions are complex the individuals must be severally acted upon in different ways by their special environments, they must tend to vary so as to suit those environments, and be, "in so far, unfitted for the average habits proper to the species. But these undue specialisations are continually checked by gamogenesis." Thus the individual differences which would, if agamogenesis were the only means of multiplication available, be a bane, are by gamogenesis turned into a positive advantage. Any member of a class of organisms which had previously multiplied by agamogenesis would, if gamogenesis should become available to it, thereby get an advantage over its fellows and rise into higher society. Thus we can account for the fact that the gamogenetic act not only becomes more common as we rise in the organic scale, but also less incidental, and a more serious and regular part of the life-history of the species. We can trace it from its origin in what was a mere chance fusion of two individuals to the highly specialised form in which it occurs in the highest vertebrates.

But there is more than this, I think. It is a common truth that in agamogenetic modes of multiplication more individuals are produced than by gamogenesis. Therefore, if the species maintains its ground, more individuals must die, proportionately, in the former case than in the latter. Those that die must have been less fitted for the average life of the species; so also must their offspring be, if they produced any before death. But in gamogenesis, cross-fertilisation and to a less extent self-fertilisation neutralise that "fatal narrowness of adaption" which tends to arise, and, in so far, requires the production of fewer young to ensure the continuance of the species. This is another advantage of gamogenesis.

Finally, we must not suppose that this theory will explain everything. We must be content if it gives an intelligible reason for the cardinal facts and most of the details, leaving the apparent exceptions to be cleared up by future research.

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(Continued from page 104.)

9.—*The Longmynd Hills and the Stiper Stones.*—West of Church Stretton the Lower Cambrian rocks, striking north-east and south-west, occupy a breadth of six miles, rising in the Longmynd Hills to a height of 1,674 feet. They consist of grey, purple, or green grits, sandstones, slates, and conglomerates, whose thickness, unless they are repeated by strike-faults or folds, which, however, seems very probable, must be as much as 25,000 feet. We see neither the base nor the top of these beds, for they are bounded by great faults both on the east (near Church Stretton) and on the west. The western line of fault runs along the centre of the valley, which separates the Longmynd Hills from the ridge of the Stiper Stones. In this valley Dr. Callaway has recently detected numerous small bosses of Pre-Cambrian strata, of which Pontesford Hill occupies the largest area. Still walking westward we find the ascent to the Stiper Stones to be composed of the Shineton Shales. The Stiper Stones themselves are quartzose sandstones distinguishable lithologically, and by the fact that they contain an Arenig fauna, from the Wrekin quartzite. They may be regarded as forming the true base of the Silurian system, and are comparable with the *Gres Armoricain* of Brittany. They are overlaid by Arenig Shales, beyond which Upper Silurian rocks stretch westward into Wales.

10.—*The Malvern Hills.*—About thirty miles south-east of Church Stretton we find the Malvern Hills. They rise in conical masses from the plain of the Severn, being bounded on their eastern side by a fault of great magnitude. Gneissic and granitoid rocks form the core of the range, and are well exposed at the Herefordshire Beacon, Worcester Beacon, and North Hill. These are overlaid by indurated volcanic rocks, ashes, and hälleflintas, certainly belonging to the Pebidian division of the Pre-Cambrian era. Dr. Callaway has identified both these varieties of rocks in the Wrekin district.* The rocks exposed below the Quartzite at the Lickey, and at Hartshill, in all probability belong to the Pebidian formation, together with the entire series of the Charnwood rocks.

On the west side of the Malverns we find the Hollybush Sandstone resting upon the Pre-Cambrians (the Quartzite being absent), while above it are the Malvern Shales (comparable in part with those at Shineton and Stockingford). All the Lower Silurian strata are missing, but the Upper Silurians are in full force, the May Hill Sandstone forming their base, and they extend northwards to Abberley, and westwards until they disappear beneath the Old Red Sandstone.

II.—Borings which have reached the Pre-Carboniferous Rocks in the Midlands.—"Soundings on land," in search of either coal or water, have been executed at numerous points within the Midland Counties during the last few years.

* Quarterly Journal Geological Society, Vol. XXXVI., p. 536.

Locality.	Lowest Mesozoic Formation found.	Palæozoic Formations reached.	Extreme depth attained.	Depth of Palæozoic Rocks below Sea-Level.
Netherfield, near Brighton	Middle Oolite		1900	—
Caterham	Lower Greensand		874	—
Richmond, Surrey	Trias		1409	—
Crossness (near Blackwall)	Trias?		1075	—
London (Tottenham Court Road)	Great Oolite (64ft.)	Upper Devonian (red and green shales)	1134	980
N. London (Kentish Town)	Trias?		1302	—
Turnford (near Cheshunt; 14 miles north of London)	Gault (164ft.)	Upper Devonian	950	835
Ware (6 miles north of Turnford)	Gault (160ft.)	Upper Silurian (Wenlock Shale)	845	710
Gayton (5 miles S.W. of Northampton)	Trias (60ft.)	Lower Carboniferous	994	417
Northampton (Bridge Street)	Trias (54ft.)		650	—
„ (Kettering Road; 1 mile N.E.)	Trias (67ft.)	Lower Carboniferous	851	527
„ (Kingsthorpe, 2½ miles N.E.)	Trias		967	—
Orton (12 miles N.E. of Northampton)	Trias (24ft.)	Pre-Cambrian	789	341
Rugby	Trias (Waterstones)		1145	—
Sapcote (near Hinckley)	Trias	Cambrian	1655	150?
Leicester, Spinney Hills, I.	Trias		750	—
„ „ „ II.	Trias	Cambrian	819	450?
„ (near Evington)	Trias	Cambrian	1002	450?
Owthorpe (South Notts)	Trias (1,000ft.)	Coal-Measures	1066	900?
South Scarle (between Lincoln and Newark)	Permian (519ft.)	Coal-Measures	2029	1900?

Thanks to the modern appliances by which such borings are executed, depths of from 800 to 2,000 feet have been readily reached; with the result that old rocks have been pierced at several points, and specimens in the form of "cores" brought to the surface.

The preceding list includes borings which have been made along a line extending nearly due north and south, from Scarle in Lincolnshire to Netherfield near Brighton. It shows in each case:—(1.) The lowest Mesozoic formation found; (2.) The Palæozoic formation upon which this Mesozoic rock rested (in those cases where the Palæozoic rocks were reached); (3.) the extreme depth to which the bore-hole descended; and (4.) the depth of the old Palæozoic surface below the present sea-level. Detailed sections of several of these deep borings have been already given by me in the pages of the "Midland Naturalist." *

Commencing on the south this chain of borings revealed an unexpected thickness of Oolitic strata below Sussex.

The Caterham boring disappointed those who hoped to obtain a water-supply for London from the *Lower Greensand*, which only a few miles further south is of considerable thickness. At Caterham this bed is only twenty feet thick, showing that we are quite close to its old shore-line, of which there are indications at its outcrop (round Sevenoaks) in the shape of numerous pebbles of quartzite and other hard rocks.

The Richmond boring showed below the Gault eighty-seven feet only of Oolitic strata, resting on red rocks (probably Triassic), in which the boring terminated. Under London only one boring has actually reached the Palæozoic axis, viz., that at Meux's Brewery in the Tottenham Court Road, where red and green Upper Devonian Shales were found to contain fossils of types such as occur in the Eifel district—*Spirifera Verneuilii* for instance. Mr. Whitaker† has pointed out that this strongly bears against the theory that the red beds at the bottom of the Kentish Town and the Crossness borings can be Old Red Sandstone, since in no known locality are the two types—the Devonian and the Old Red—found in such close proximity.

At Turnford the Gault rested upon purple Devonian Shales, and at Ware upon Upper Silurian (Wenlock) Shales. The four Northampton borings clearly proved the Trias there to

* Midland Naturalist, Vol. III., p. 188.

† Quarterly Journal Geological Society, Vol. XL., p. 724. Geology of London, p. 21.

be very thin—a mere littoral accumulation, sixty or seventy feet in thickness—resting upon a degenerate representative of the Mountain Limestone, evidently also deposited close to an old coast-line. Some hard red marls and coarse grits and sandstones at the very bottom of the Gayton boring have been assigned to the Old Red Period, but it is more probable that they are Lower Carboniferous.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE

CONSIDERED

1.—STRATIGRAPHICALLY.

2.—PALÆONTOLOGICALLY.

3.—AS A SOURCE OF BUILDING STONE, ROAD METAL AND IRONSTONE.

4.—AS A SOURCE OF WATER SUPPLY FOR TOWNS AND VILLAGES.

5.—AS A RECEPTACLE FOR WATER, WHEREBY FLOODS MAY BE MITIGATED.

BY BEEBY THOMPSON, F.C.S., F.G.S.

INTRODUCTION.

For several years the town of Northampton has had a very short supply of water, and yet during some portion of this period the district around has been subject to excessive and destructive floods. It is very commonly believed that excessive agricultural drainage is one of the chief causes of both these evils. My own ideas of the matter will be sufficiently explained later on, but it may be as well to state at once that the primary object of this treatise is to show that the Middle Lias of Northamptonshire, which is the chief water-bearing bed to the west and south-west of Northampton, offers considerable facilities for remedying the condition of things above referred to by one operation—that of artificially letting in to the porous beds of the district the water which is now largely kept out by natural and artificial means. This explanation will account for, and I hope excuse, the introduction of a section dealing with the springs of the county generally.

PART I.

The Middle Lias of Northamptonshire considered Stratigraphically.

There is considerable difference of opinion amongst geologists as to the vertical limits of the Middle Lias, particularly downwards, so it is necessary for me at the outset to state explicitly what I consider to be Middle Lias in Northamptonshire, and my reason for claiming this and no other as belonging to the period in question.

To all who have studied the Lias deposits in England it must be evident that there was no great break in the continuity of the series at any time, and it is more than probable that, so far as the Lower and Middle Lias are concerned, a break at one place is represented by a continuous deposit at another. Such being the case, it appears to be only necessary to accurately state where the line is drawn in any locality by the local geologists. Professor Judd, in his "Geology of Rutland, &c.," places this matter, which is still one of controversy, in a very clear light; and I am sure I need offer no apology for quoting some of his remarks on the matter.

The Lias formations were first divided into "Upper," "Middle," and "Lower," by Phillips, in a book published in 1829:—"Illustrations of the Geology of Yorkshire." Part I., "The Yorkshire Coast."*

Louis Hunton was probably the first geologist who made the attempt to localise fossils, and so divide formations into zones characterised by a particular fauna; and a paper of his on this subject was published in Vol. V. of the second series of the "Geological Transactions," in 1836. This was followed by another paper in the same volume, by W. C. Williamson, which was an attempt to divide the whole of the Lias into zones.

Quenstedt, in 1843, divided the Lias into six stages, $\alpha\ \beta\ \gamma\ \delta\ \epsilon\ \zeta$. Dr. Albert Oppel, in 1856, published a work as the result of his study of the German and English Lias (chiefly Yorkshire, I think), in which Hunton's ideas of Palæontological zones was more completely developed; and since then this method of dividing the various formations, particularly the Lias and Oolites, has been largely followed.

* "The Yorkshire Lias," by Messrs. Tate and Blake.

TABLE SHOWING THE DIVISION OF THE LIAS SYSTEM INTO ZONES.

† Divisions of Quenstedt.	† Continental Classification.	† English Geol. Survey.	* Zones adopted by Tate and Blake.	† Zones adopted by Judd.	* Zones adopted by Oppel (1856).	* Zones adopted by Wright (1860).
ζ	Upper Lias.	?	Zone of Ammonites jurensis.	Zone of A. jurensis.	Not recognised.	Upper Lias Sands.
ε		Upper Lias.	Zone of A. communis.	Zone of A. communis.	Zone of Posidonomya Bronnii.	Alum Shale.
			Zone of A. serpentinus.			
δ	Middle Lias.	Middle Lias.	Zone of A. annulatus.	Not recognised.		
			Zone of A. spinatus.	Zone of A. spinatus.	Zone of A. spinatus.	
			Upper Zone of A. margaritatus.	Zone of A. margaritatus.	Upper Zone of A. margaritatus.	
			Lower Zone of A. margaritatus.		Lower Zone of A. margaritatus.	
γ		Lower Lias.	Zone of A. capricornus.	Zone of A. capricornus.	Zone of A. Davæi.	
			Zone of A. Jamesoni.	Zones of A. ibex and A. Jamesoni.	Zones of A. ibex and A. Jamesoni.	Zone of A. Jamesoni.
			Region of A. armatus.	Zone of A. armatus.		
β	Lower Lias.		Zone of A. oxynotus.	Zone of A. oxynotus.	Zone of A. raricostatus.	Zone of A. raricostatus.
					Zone of A. oxynotus.	Zone of A. oxynotus.
				Zone of A. obtusus.	Zone of A. obtusus.	Zone of A. obtusus.
α			Upper Zone of A. Bucklandi.	Zone of A. semicostatus. (A geometricus. Oppel.)	Tuberculatus bed. (These divisions established on inference only.)	
			Middle and Lower Zone of A. Bucklandi.	Zone of A. Bucklandi.	Zone of A. Bucklandi.	
			Zone of A. angulatus.	Zone of A. angulatus.	Zone of A. angulatus.	
			Zone of A. planorbis.	Zone of A. planorbis.	Zone of A. planorbis.	

Quoted from "The Yorkshire Lias," by Messrs. Tate and Blake. † Quoted from "The Geology of Rutland," by Jno. W. Judd, F.G.S.

This table to a large extent explains itself, but a few remarks on it are perhaps advisable; thus, taking the divisions of Quenstedt as a starting point, it appears that the Continental —particularly German—geologists, take the divisions α and β as Lower Lias, γ and δ as Middle, and ϵ and ζ as Upper, though some of the French geologists carry the Middle Lias lower down, and make it to include a good part of β. Each of these divisions may be justifiable in the district where it is adopted, but not so in others. The classification most commonly adopted in England is that which regards all the zones from that of *A. annulatus* to *A. armatus*, both inclusive, as Middle Lias; though in the English Geological Survey they draw the line between the zones of *A. margaritatus* and *A. capricornus;* and Mr. R. Tate, in a paper in the "Journal of the Geological Society" for August, 1870,* has given reasons for drawing the line of demarcation between the zones of *A. obtusus* and *A. oxynotus*. Mr. Tate's reasons are entirely palæontological, and are based on a study of the Gloucestershire Lias in the Cheltenham district.

So far as Northamptonshire is concerned there seems to me little doubt that the divisions adopted by the Geological Survey are justifiable for the following reasons, which also hold good in most of the North Midland counties.†

1.—There is a very marked change in the mineral character of the beds when the zone of *Ammonites margaritatus* is entered, sands, sandy shales, and ferruginous limestones being met with instead of clays.

2.—The division is quite defensible on palæontological grounds, for the ammonites of the group of the Capricorni disappear entirely and are replaced by the Amalthei group.

3.—Very much confusion and ambiguity is saved, and the mapping of the district much facilitated, by drawing the line of demarcation between a set of sands and clay, for not only are they more easily distinguished in a section but the line of division is often sharply indicated by a line of springs; whilst it is almost impossible to draw a line of boundary in the midst of a series of clays of almost uniform character, like those composing the beds below this division.

Whether the classification adopted by the English Geological Survey is best or not for general purposes it is certainly the best for use here, because it gives almost exactly

* "On the Palæontology of the Junction Beds of the Lower and Middle Lias of Gloucestershire," by Ralph Tate, Esq., Assoc. Lin. Soc., F.G.S., &c.

† See "The Geology of Rutland," by Jno. W. Judd, F.G.S. Introductory Essay.

the limits of the set of beds I intend to describe under the head of the Middle Lias, though a term such as "Upper Middle Lias" might be preferable, and is indeed at times used.

There is not much difficulty in fixing the upward limit of the Middle Lias, although what I shall in this paper call the Transition Bed has been variously named, and variously classed, and sometimes ignored. Mr. Day* calls this bed the *Pleurotomaria Bed*, as it exists in Dorsetshire. In Yorkshire its equivalent has been described by Messrs. Tate and Blake, under the name of the Zone of *Ammonites annulatus*, and in the Midland Counties we commonly call it the *Transition Bed*, a name first used by Mr. E. A. Walford, F.G.S.† There is a decided mixing of Middle and Upper Lias fossils, and the ammonites in this bed are almost entirely Upper Lias; nevertheless there is such a large preponderance of Middle Lias fossils that there is scarcely a doubt as to where it should be placed. I have between ninety and a hundred species from this bed in Northamptonshire, and I believe quite three-fourths of them would be regarded as Middle Lias.

(To be continued.)

METEOROLOGICAL NOTES.—March, 1885.

The barometer experienced several fluctuations during the month, and some of the changes of pressure were both sudden and rapid. On the 14th the reading was 30·630 inches at Loughborough, at 8 a.m., its highest point. Temperature was below the average, the mean being 2·4° less than that of February; the range was smaller than usual for the time of year. The highest maxima were 60·0° at Henley-in-Arden, on the 20th; 58·4° at Hodsock, 53·7° at Strelley, and 53·5 at Coston Rectory, on the 17th; and 55·5° at Loughborough, on the 28th. In March, 1884, the highest maximum at Loughborough was 69·1°. In the rays of the sun 117·1° was registered at Hodsock, and 101·2° at Strelley, on the 17th; and 105·8° at Loughborough, on the 27th. The lowest minimum readings were 22·5° at Coston Rectory, on the 24th; 23·5° at Hodsock, on the 2nd; 24·4° at Loughborough, on the 15th; 26·0° at Henley-in-Arden, on the 15th; and 28·0° at Strelley, on the 2nd and 23rd. On the grass, the thermometer recorded 17·3° at Hodsock, 18·1° at Strelley, and 20·2° at Loughborough, on the 23rd. The rainfall was below the average, the

* "On the Middle and Upper Lias of the Dorsetshire Coast," by E. C. H. Day, Esq., "Quarterly Journal of the Geological Society," August, 1863.

† "On Some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford; "Proceedings of the Warwickshire Naturalists' and Archæologists' Field Club," 1878.

total values being 1·21 inches at Strelley and Henley-in-Arden, 1·06 at Hodsock, 0·83 at Loughborough, and 0·79 at Coston Rectory. The greatest fall occurred at each station on the 3rd, and the number of "rainy days" ranged from 11 to 15. The greater portion of the rain fell in the earlier days of the month, so that vegetation was not sufficiently advanced to suffer much injury from the frequency of radiation frosts. Snow fell on the 6th, 18th, 20th, and 21st. Sunshine was deficient. The wind varied in direction, and was not of so much force as is customary in March. The dry nature of the soil was highly advantageous for farming operations.

WM. BERRIDGE, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

THE MIDLAND UNION.—The following arrangements for the Annual Meeting in June are nearly completed:—on the morning of June 16th, the Committee will meet in the Council Chamber at the Council House; in the afternoon the General Meeting will be held in the Examination Hall at the Mason College; and in the evening there will be a Soirée in the Town Hall, when the electric light will be used for illumination instead of gas. On the 17th, there will be three excursions; one to Kinver and Enville, one to Cannock Chase, and one to Bromsgrove Lickey. The reception room will be in the Library of the Birmingham Natural History and Microscopical Society in the Mason College. We hope to see delegates and friends from all the Societies in the Union.

BRITISH ASSOCIATION.—Arrangements as to the accommodation of the British Association in Aberdeen at its meeting in September are now being finally made, in consonance with the suggestions of Professor Bonney in April last. In addition to £2,000 obtained by personal application, other sums have been received for the guarantee fund, in answer to a circular recently issued. It has been arranged that the Artists' Society shall hold its exhibition during the session of the Association, instead of in the summer months, and that it shall be open free to members of the Association; natural history and archæological exhibitions have also been proposed, as well as a project for establishing telephonic connection between the various halls placed at the disposal of members.

HERMAPHRODITISM OF GERMIGENAL CELLS.—The development of ova and spermatozoa has of late years formed the subject of many elaborate researches, the latest of which by E. Van Beneden is full of importance and interest. The phenomenon of the separation of polar vesicles from the ovum has been regarded by some authorities, including the late Professor Balfour, of Cambridge, as simply a case of cell-division, and by others as the exclusion of the male element from the originally hermaphrodite ovarian cell. Since the phenomenon does not occur in cases of Parthenogenesis the latter theory seem very probable; but, on the other hand, the obvious question is whether any similar exclusion of a female element from the spermatozoon takes place, and hitherto no satisfactory instance has been given. In his last paper, Van Beneden, who is a strong upholder of this theory, states that the male germigenal cell before its development into spermatozoa throws off a globule which he regards as the female element of the nucleus. We shall await with interest the confirmation or disproof of this remarkable statement.

"A WARNING FROM THE BRITISH COAL-FIELDS" is the title of a pamphlet published in Liverpool, which advocates the formation of a national association, the purpose of which should be to inquire into the exhaustion of our coal. At the present rate the author thinks British coal will come to an end in 110 years. It is to be regretted that such an alarming statement should be made except on the most trustworthy authority. We call attention to this pamphlet mainly to remind our readers that the Royal Coal Commission, whose report was published in 1871, gave nearly 450 years for the duration of the coal to the depth of 4,000 feet. In the zone exceeding that limit a quantity of coal which amounts to 48,465,000,000 tons is believed to exist.

EYES ON SHELLS.—Professor Moseley has lately discovered the presence of eyes on the shells of certain Chitonidæ. They are restricted to the exposed areas of the outer surfaces of the shells—that is, to the *tegmenta* of Carpenter. Each eye lies in a pear-shaped pit, which is covered externally by a calcareous cornea. The cavity of the pit is lined by a dark brown pigmented substance, which curves inwards beneath the cornea, forming a sort of iris. The lens, which is perfectly transparent, hyaline, and strongly bi-convex, lies behind the iris aperture. The fibres of the optic nerve, within the pigmented cavity, become separated from one another and loose, and pass directly to a retina composed of a single layer of short well-defined rods. The absence of eyes has hitherto been regarded as a characteristic of the Chitonidæ, and the ignorance of their existence is, perhaps, due to the fact that they do not occur in any common European representative; they are not easily seen in dried specimens of shells, which require to be moistened with spirit before the eyes become visible; and Schizochiton, in which they are largest and most evident, is a rarity in museums.

COLOURED SOUNDS.—It is said that the blast of a trumpet has been compared to scarlet, and a serious dissertation has been written on the problem "Of what colour is A flat." But, joking apart, the phenomenon of coloured hearing has now a recognised scientific place. In "La Nature," April 18th, 1885, M. de Rochas gives an account of several observations which have been made on the subjective colours associated with sounds in certain persons. A man examined by Dr. Pedrono, of Nantes, perceived a different colour for each musical note; neighbouring notes produced similar colours: the high notes were accompanied by brilliant colours and the low by sombre ones. A musical chord produced a single colour, the resultant of those due to the separate notes; if the chord contained a dissonance, the colour proper to that appeared as a detached patch near to the other. Human voices appeared coloured according to their *timbre;* yellow, red, green, and blue voices could be distinguished, the blue voices being the commonest; green voices were very rare. An Italian, Doctor Z., examined by M. Ughetti, attached different colours to different vowels; thus *a* was black! *é* yellow, *i* red, *o* white, and *ou* coffee-coloured (the vowels of course bearing their continental pronunciation.) In conversation the rapid succession of vowels generally prevented the Doctor from perceiving the colour due to each; but if a word contained the same vowel several times repeated then the colour became distinct; thus *ballata* was black, *néré* yellow. Other similar cases, differing, however, in their details, are known, and M. de Rochas promises to describe one which he has himself met with, still more interesting than those now given.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section. March 24th. T. H. Waller, Esq., in the chair. Exhibits:—1. Mr. J. E. Bagnall. A number of mosses from near Stockingford, including *Hypnum molluscum*, *H. chrysophyllum*, *H. pumilum*, *Tortula spadicea*, *Fissidens tamarindifolius*, &c. 2. Mr. T. H. Waller. The following sections:—(*a*) Red vein in Rowley Rag, showing radiating zeolite; (*b*) Rowley Rag, showing parallel arrangement of plates of ilmenite; (*c*) Very coarse Rowley Rag, showing large quantities of apatite; (*d*) Rowley Rag from Tansley Hill, showing microporphyritic structure and fluidal arrangement; (*e*) Grey vein in Rowley Rag, showing long blade-like crystals of orthoclase; (*f*) Grey vein in Rowley Rag, showing inclusions in the glassy base; (*g*) Rowley Rag from Hailstone Hill, showing olivine; (*h*) Rowley Rag from Tansley Hill, Dudley, showing microporphyritic structure. Mr. Allport then took the chair, while Mr. Waller read his paper, entitled "Some recent observations on the structure of Rowley Rag." After the paper, a very interesting discussion ensued. Mr. Waller congratulated the section on once more having Mr. Allport in the chair.—General Meeting. March 31st. Mr. James Mathews, Clent, sent for exhibition *Thuja occidentalis* covered with blossom. Mr. W. B. Grove, B.A., exhibited the following fungi:—*Schizophyllum commune* and *Œcidium grossulariæ*, collected by Mr. W. H. Wilkinson in America; also *Œc. phlogis*, *Œc. podophyllatum*, *Œc. convallariæ*, *Œc. porosum* and *Hypocrea citrina*, all from Iowa, U.S.A.; *Sphærella pinodes*, from Ireland; also from this neighbourhood *Helmint hosporium cylindricum*, *Hyalopus ater*, *Acrothecium tenebrosum* (all three new to Britain), *Hypomyces candicans* (very rare), and *Entyloma ranunculi*. Mr. W. H. Wilkinson read his paper on the "Flora of N. America," and exhibited 85 sheets of specimens collected, containing nearly 150 different species, including many curious and interesting plants. Mr. T. Bolton exhibited living specimens of *Balanus balanoides*, also the larval (Narplius) form, under the aquarium microscope.—Sociological Section. April 2nd. At this meeting Mr. F. J. Cullis tendered his resignation as hon. secretary, in consequence of the pressure of his engagements. It was unanimously resolved that the best thanks of the section be presented to Mr. Cullis for the able and courteous manner in which he has fulfilled the duties of the office. Mr. Alfred Browett was unanimously appointed as his successor. Mr. Browett then read, with illustrative comments, Chapter III. of Mr. Herbert Spencer's *Study of Sociology*, "Nature of the Social Science," upon which an interesting discussion followed. A suggestion that a second excursion should be made to George Eliot's Country early in June next met with approval.—Biological Section. April 14th. Mr. R. W. Chase in the chair. Mr. T. Bolton exhibited the larval form of the common fresh-water mussel, *Anodon cygneus*; the rose beetle, *Cetonia aurata*, sent by Mr. Sylvanus Wilkins, and discovered in an old thatched roof near Lyme Regis; and also one of the Jungermanniæ, *Pellia epiphylla*, from Sutton Park. Mr. J. Levick, a fine gathering of *Volvox globator* and *Argulus foliaceus*. Mr. W. H. Wilkinson, *Helleborus viridis*, *Hepatica trilobata*, *Omphalodes verna*, and a lichen (*Peltigera canina*) in fine fruit, all from Blockley, Worcestershire. Mr. J. E. Bagnall, *Webera carnea*, *Eurhynchium piliferum*, *Hypnum cordifolium*, and other mosses from the Anker district. The Rev. H. Boyden then read a paper, "Natural History Rambles in the Neighbourhood of Llandudno." Having first given a very interesting and humorous description of the various scenes and episodes to be noted by the observant visitor to such places during the tripping season, he then passed on to notice some of the geological features of the district, then the seaweeds and corallines, mosses and flowering plants, illustrating his remarks by a fine and beautifully prepared collection of the various objects; among the more rare were *Trollius Europœus*, *Helianthemum canum*, *Frankenia lævis*, *Geranium sanguineum*, *Erodium maritimum*, *Spiræa Filipendula*, and many others. A discussion followed, in which Messrs. R. W. Chase, J. E. Bagnall, W. B. Grove, J. Morley, and W. H. Wilkinson took part. Mr. Boyden also presented to the library of the Society a carefully prepared MS. list of over 250 flowering plants noticed in the Llandudno district.—MICROSCOPICAL GENERAL MEETING. April 21st. Mr. W. P. Marshall, M.I.C.E., explained the new process of continuous section cutting, the apparatus for which he described from a diagram, and illustrated it by the exhibition of a series of twenty-nine slides with eight hundred sections of the Pennatulida, prepared by Dr. A. M. Marshall and himself. The slides were shown under about a dozen microscopes, and the members were much interested and pleased with the very successful results. Mr. Frederick Fitch, F.R.M.S., exhibited a series of exquisitely mounted specimens of dissections, showing the anatomy of the earwig, snout fly, &c., which he had prepared himself. Mr. W. H. Wilkinson exhibited three lichens, finely in fruit, from Blockley, viz., *Physcia ciliaris* var. *actinota*, *Evernia prunastri*, and *Parmelia physodes*. Although the two latter are amongst our commonest tree lichens they are very rarely found in fruit.—SOCIOLOGICAL SECTION. April 16th. The President, Mr. W. R. Hughes, F.L.S., in the chair. Mr. W. H. France read a paper on Chapters VIII., IX., X., of part 3, of Mr. Herbert Spencer's *Principles of Biology*, "How is Organic Evolution Caused?" "External Factors," "Internal Factors." Speeches upon the subjects treated were delivered by the President, Dr. Hiepe, Mr. F. A. Walton, and Miss Naden, and a generally interesting discussion followed, in which all the members present took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 23rd. Mr. Insley exhibited remains of fossil fish from the Lower Lias formation of Lyme Regis. Mr. Tylar described the use of osmic acid in the preparation of microscopic objects, and showed a number of slides of entomostraca, &c., prepared by it that retained a life-like appearance. Mr. J. W. Neville showed, under the microscope, *Carchesium polypinum*.—March 30th. Mr. H. Hawkes exhibited a male specimen of the four-horned spider crab, *Pisa tetraodon*; Mr. Madison, specimens of *Zonites radiatulus*; Mr. F. Shrive, two living adders taken a few days previously in Sutton Park. Under the microscope, Mr. Tylar showed a section of coralline limestone, and also one of pentacrinite from Lyme Regis. Mr. Moore, palate of slug, *Testacella haliotoidea*; Mr. H. Hawkes, *Batrachospermum moniliforme*, showing oospores; Mr. Insley, fossil polyzoa, from the mountain limestone.—April 13th. Mr. J. W. Neville showed a collection of marine algæ from Weymouth; Mr. Madison, leaf impressions from Tertiary beds, near Bournemouth; Mr. Sanderson, specimens of *Jungermannia bidentata*. Under the microscope, Mr. Moore showed stomach of green saw-fly, containing pollen and insect remains; Mr. Tylar, *Hydra vulgaris*, greatly distended through swallowing a phantom larva; Mr. H. Hawkes, *Epistylis grandis*, and *Vorticella nebulifera*; Mr. Grew, operculum of *Cyclostoma elegans*. Mr. J. Betteridge presented to the Society, as a first instalment, nineteen specimens of birds preserved and set for the cabinet, in illustration of his series of papers on "The Birds of the District," recently read before the Society. They included, among the less common birds, specimens of the golden-crested wren, *Regulus cristatus;* great titmouse, *Parus major*; Kingfisher, *Alcedo ispida*; and great crested grebe, *Podiceps cristatus.* A hearty vote of thanks was accorded to Mr. Betteridge for his kind gift and his zealous labours in popularising ornithology. Mr. Betteridge replied, and intimated that the second instalment, including many of our summer visitors, would be ready in the early part of July.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, April 15th, attendance nine (two ladies). Exhibits: *Pellia epiphylla*, in fruit, one of the larger hepaticæ, by Mr. Quilter. Cells of the common wall bee, *Osmia rufa*, taken from an old mud wall, containing pupæ in two stages, some in which the larvæ were only just enclosed, others in which the perfect insect was ready to emerge, and from one of which, on being broken, the live bee escaped and crept about, its wings being not yet dry enough for flight; also several Coleopterous and Dipterous larvæ found in a ball of bee-bread in another cell, and a number of mites from an empty cell, where they appeared to be feeding on the propolis with which it was lined, by Mr. W. A. Vice. Several numbers of the periodical Cole's "Microscopical Science," containing finely executed coloured figures of microscopic objects, accompanied by slides, by Mr. W. E. Grundy; Dumortier's "Hepaticæ Europæ," with coloured plates, price 10s.; and Watson's "Topographical Botany," price 16s.; also a square of compressed camphor, very suitable for use in cabinets and herbaria, by the chairman. Paper "On the *Ricciaceæ*," by the chairman, illustrated by specimens, and a coloured drawing of *Riccia glauca*, recently collected from a shady bed in his garden at Birstal Hill. This species had not hitherto been recorded in Leicestershire, although it was perhaps the one referred to in Coleman's list under the name of *R. crystallina*. The fruit of these abnormal Hepaticæ was particularly curious and interesting, each of the hard black spores being shaped like the fourth part of a sphere, rounded on one side and pyramidal on the other.

THE CARADOC FIELD CLUB.—The annual meeting of this Club was held at Shrewsbury, March 19th, the Rev. J. D. La Touche, president, in the chair. After re-electing the officers and transacting the other ordinary business of the club, the following programme for the coming season was fixed upon:—Tuesday, May 19th, Titterstone Clee Hill; Wednesday, June 17th, Bishop's Castle, for the Bishop's Moat and Offa's Dyke; Tuesday to Thursday, September 28-30, to Cader Idris, North Wales; Friday, October 9th (subject to alteration), Pontesford Hill and Abberley Valley. This last meeting has for its special object the study of cryptogamic botany. The Club has made it a practice for some years past to offer prizes to the children in the National Schools in the county, up to fourteen years of age, for the best collections of fossils, wild flowers, and insects. Three competitors appeared with collections of fossils, each of which was considered worthy of a prize. These collections were purchased by the Club and presented to the Shrewsbury Free Museum. The completion and publication of "A Handbook to the Geology of Shropshire," by the President, to the cost of which a grant had been made from the funds of the Club, was a subject of warm congratulation, especially as the sale of the work had already been so large as to secure its financial success.

ON THE INTERCELLULAR RELATIONS OF PROTOPLASTS.—IV.

BY WILLIAM HILLHOUSE, M.A., F.L.S., ETC.

(Continued from Vol. VII., p. 126.)

Having at times probably a genetic relationship with sieve tubes are the articulated latex vessels, an interesting memoir on which was published in 1882 by D. H. Scott.* Dippel† had believed the resemblance to be sometimes carried to the extent of the presence of sieve-like perforations in the septa, as in *Chelidonium* and *Papaver*, and of actual lateral sieve-plates in the same genera, thus producing intermediate structures between sieve tubes and latex vessels. It must, however, be borne in mind that the conception of a sieve plate has greatly developed since 1863. A sieve plate, as has been fully noted earlier in this paper, has special structure besides its mere sieve-like perforation; and while it is quite true that the septa of latex vessels are often perforate, and that not merely by one, but often by a group of perforations, they are large in size, irregular in outline, and altogether devoid of callus.

Thus far, therefore, sieve tubes must be regarded as the only structures in which any approach to protoplasmic continuity (not bodily) had been universally recognised; and even with these it must be especially remembered that the protoplasmic threads connecting the contents of the adjoining cells constituting the tubes are products of protoplasmic activity, and are not relics of initial unity. They are the last term of a series of resorption phenomena which manifest themselves in so many stages of vegetable development—the fusion of the conjugating canals in Zygnemaceæ and Mucorinæ, the union of rows of cells into vessels and ducts, the anastomosis of cells in a latex system, the peculiar wood cells of the mistletoe (*Viscum album*).

It remained for Tangl‡ to open up, in 1879, a new vista of possibilities in a memoir, in which he demonstrated the

* D. H. Scott, B.A., "The Development of Articulated Laticiferous vessels," Q. Journ. Mic. Sc., 1882, pp. 136—153 and 1 plate.

† Dippel, "Entstehung der Milchsaftgefässe," Verhandl. d. Bataafsch. Genootschap, &c., te Rotterdam, tom. XII., p. 3 (1863).

‡ Tangl, "Ueber offenen Communicationen zwischen den Zellen des Endosperms einiger Samen." Pringsheim's Jahrbücher f. wiss. Bot. XII., pp. 170—190, and plates 4—6.

existence of open communication between neighbouring cells in the endosperm of the seeds of certain palms—*Strychnos nux-vomica*, *Areca oleracea*, and *Phœnix dactylifera*. As this investigation of Tangl's, although describing what for some years appeared to be isolated phenomena, is still the starting point of recent research in this direction, we will give to it brief special attention.

The endosperm of *Strychnos nux-vomica* is bounded outwardly by layers of cells elongated at right angles to the surface, and therefore shown best in a section taken in this direction. The inner tissue of the endosperm, shown by sections taken parallel with the surface of the seed, and at some little distance below that surface, consists of thick walled cells, with strongly-swelling membranes. Under the influence even of water these membranes swell very greatly, and show strongly-marked lamination. If a dried section of this inner endosperm tissue is allowed to swell in dilute alcohol the lamination of the membrane is manifest, and at the same time a fine cross striation is seen in the walls of adjoining cells. But if a section of this same portion of the endosperm is treated with potassium iodide iodine, these striæ stain yellow or brown, and show as "fine threads penetrating the cell walls in their entire thickness" (see fig. 7).* For reasons derived from the relations of these striæ towards colour re-agents, Tangl came to the conclusion that the striæ were none other than delicate prolongations of the outer layer of the cell protoplasm penetrating the cell walls and communicating with one another. They are not visible in the dry state, nor in absolute alcohol, from the close relationship of their refractive index with that of the surrounding cell membrane. By absorption of water these refractive indices are changed in unlike degree, so that the threads show out in the laminated membrane with a greater or less degree of clearness, just as the lamination itself of the membrane shows for the same reason.

The endosperm of *Areca oleracea*, examined by means of sections taken parallel with the surface of the seed, and swollen in water, shows walls of considerable thickness and homogeneous structure, with local thin areas, corresponding in position in adjoining cells, but presenting no structural peculiarities. If, however, similar sections are allowed to swell in chlorzinc iodine ("Schultz's solution") until the cell-walls have taken a uniform blue coloration, it will then

* The figures illustrating this portion of the paper will be published in connection with a future instalment.

be seen that the middle lamella, separating the widened bases of the pits in adjoining walls, is penetrated by fine threads passing from pit to pit (see Fig. 8). While the more median of these threads appear to pass in a straight line from pit to pit, the lateral ones are progressively more and more curved, so as to make the figure described by the outermost elliptic, or even almost circular. (The same relations are visible in the threads passing through the normal thick parts of the walls in *Strychnos nux-vomica.*) The threads are brought out with still greater clearness when, prior to treatment with chlorzinc iodine, the section has been laid in potassium iodide iodine.

In *Phœnix dactylifera* sections of the endosperm taken parallel to the surface of the seed, as well as at right angles with it, first saturated with potassium iodide iodine solution, and then allowed to swell in chlorzinc iodine, show a structure analogous if not similar. The thickened walls of the cells show numerous strongly-marked pits, corresponding in position in adjoining walls. The unthickened wall separating the bases of the pits, stained feebly yellow, is seen clearly to be pierced by dark yellow or brownish rods. These rods, likewise, are protoplasmic in nature.

It will be seen, therefore, that Tangl claimed to have found in these seeds evidence of protoplasmic continuity of a clear kind. In *Strychnos nux-vomica* the protoplasmic threads pass through the thickened wall at, practically, any point of its periphery, excepting perhaps at the actual angles of the cells, and are of extreme tenuity; while in the case of *Areca oleracea* and *Phœnix dactylifera* the threads are somewhat coarser, in the latter notably so, and pass only through the unthickened parts of the cell wall, *i.e.* through the closing membrane of the pits.

While carefully guarding himself against the suggestion of the general occurrence of such protoplasmic threads even in the group of palms, Tangl closes his memoir with the following important sentences:—

"Ueberblicken wir die gewonnenen, in der vorliegenden Abhandlung niedergelegte Resultate der Untersuchung, so wird durch dieselben die Thatsache festgestellt, dass die verdickten Membranen des Endosperms einiger Samen von einem System von Verbindungskanälen durchzogen werden, durch welche eine offene Communication zwischen benachbarten Zell-elementen und ein continuirlicher Zusammenhang ihrer Protoplasma-körper hergestellt wird.

Der Umstand, das die Darstellung des beschriebenen Baues in den verdickten Membranen des Endosperms in systematischer Beziehung sehr weit abstehender Pflanzen gelungen ist, darf der Hoffnung berechtigen, dass wir demselben auch noch bei anderen Objecten begegnen werden."

This "open communication between neighbouring cell-elements" and "continuity of their protoplasmic body," which Prof. Tangl ventured to hope would be found in objects other than those in which he describes it, has in the last three years been shown to exist in such widely-different plants and parts of plants as to lend foundation to a broader hypothesis of the protoplasmic unity of the entire vegetal organism.

(To be continued).

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

PART I.

(Continued from page 139.)

The parts of the Lias then that I am about to describe include the following divisions:—

1.—THE TRANSITION BED.
2.—THE ZONE OF AMMONITES SPINATUS.
3.—THE ZONE OF AMMONITES MARGARITATUS.

These divisions include twelve distinct beds, six of them being fairly hard and six soft. Below is what may be regarded as a typical section for the county, or perhaps I should say the west and south-western parts of the county, for there only can all these beds be seen.

TYPICAL SECTION OF THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

"TRANSITION" BED.

	Aver. thickness. Ft.	In.
A.—Soft grey marl, or stone, passing upwards into red sandy clay, containing *Ammonites acutus* and small *gasteropods* in great abundance	0	6

"SPINATUS" ZONE.

	Ft.	In.
B.—Rock bed.—A calcareous and ferruginous rock, containing *Rhynchonella tetrahedra*, *Terebratula punctata*, *Pecten æquivalvis*, and large *Belemnites*, all in great abundance	6	0
Springs nearly always met with.		
C.—Marly clay, containing concretionary ferruginous nodules	2	0

D.—Soft sandy limestone, often shaly in character, abounding in fossils, the most common being *Pecten liasinus*, *Protocardium truncatum*, *Astarte*, &c.	3	0
E.—Sandy or marly clay ... ... 2½ft. to	8	0

"MARGARITATUS" ZONE.

F.—Soft sandy and ferruginous limestone, generally shaly; very fossiliferous. The following rather abundant:—*Ammonites margaritatus*, *Protocardium truncatum*, *Pholadomya ambigua*, *Pleuromya costata*	3	0
G.—Sandy marl or clay, micaceous and ferruginous; *Ammonites margaritatus*, *&c.*	6	0
H.—Soft sandy limestone, abounding in fossils, very ferruginous, containing *Ammonites margaritatus*, *Pholadomya ambigua*, *Protocardium truncatum*, *Avicula inæquivalvis*, *Modiola*, *&c.*	3	0
I.—Sandy micaceous clay, very soft and friable ...	4	0
J.—Micaceous and calcareous sandstone; *Protocardium truncatum*, *Pecten liasinus*, *Fucoid markings*, all abundant	2	6
K.—Sandy, micaceous, and ferruginous shale or clay, abounding in fossils, mostly casts:—*Protocardium truncatum*, *Aviculæ*, *Pectens*, *Modiola*, *&c.* ..	5	6
L.—A mottled, yellow and green, shelly limestone, sometimes very hard, containing many well preserved fossils; large specimens of *Pecten liasinus* rather characteristic	2	0

Springs commonly met with.

"CAPRICORNUS" ZONE.

Dark blue clay.

I have found this typical section a very useful aid in the study of the Middle Lias of Northamptonshire, and although constructed three or four years ago with considerable diffidence, I have seen no reason for altering it materially since. It must be borne in mind, however, that the Middle Lias of Northamptonshire, like that of most districts, is a very variable formation, and so the section may be approximate only in any particular place, but certainly all the beds described do exist, as the numerous sections I shall give will show, and I think there are no others that it does not include. The variations that may be expected are these:—(1) An absence of some of the beds altogether, and this, perhaps, more often at the junction of the "spinatus" and "margaritatus" zones than elsewhere. (2) A coalescence of two or more of the hard beds cutting out the usual intervening clay. (8) A layer of fossiliferous nodules in place of the continuous bed.

The portion of the Middle Lias I am describing is often called the Marlstone, a term first used by Mr. William Smith to indicate that it contained hard stone bands. To this term there is some objection, for although it was applied to the whole of the formation between the Upper Lias and the zone of *A. capricornus*, the only part usually to be seen in the Midland district was the upper hard bed, here called the Rock bed, and so the term Marlstone got to be applied to this bed only. In Yorkshire Professor Phillips has named the equivalents of these beds the "Ironstone" and "Marlstone" series, the Rock bed itself being called the top Ironstone bed, and the lower beds the Marlstone.

Description of Beds in the "Margaritatus" Zone. Bed "L."

The only account that I can find of this, the lowest bed of the "margaritatus" zone, and of the Middle Lias as I intend to speak of it, in Northamptonshire, occurs in the "Memoirs of the Geological Survey," description of sheet 45 of the maps. It was written by Mr. A. H. Green, M.A., F.G.S., and runs as follows:—"At the base of the Marlstone hereabouts lies a bed of very hard, fine grained, dark blue limestone, giving out a bituminous smell when struck. It makes good road metal, and has been largely worked about Overthorpe. It may also be seen in a brick pit north-west of King's Sutton, where Twyford Lane crosses the canal."

There are not many sections in Northamptonshire where the lower beds of the Middle Lias can be seen, and for a considerable time I only knew of one where the lowest bed of the "margaritatus" zone was exposed; that was at Chalcomb, near to Banbury. Recently, however, we have been able to trace this bed over an area large enough to include Daventry to the north and Northampton to the north-east, the latter place being about twenty miles from Chalcomb. The bed has some decided characteristics, by which it can be usually identified; fossils are rather abundant, the matrix is peculiar, and it is a water-bearing bed. The particular condition of the bed at any place is better maintained along the line of strike than at right angles to it. Under *Northampton* it consists of a rather hard rock, yielding a fair amount of water; the matrix is green, but there are numerous patches (inclusions) of an ochreous colour, quite different to the rock itself, and so giving to it a peculiar mottled appearance. The green part is concretionary, and quite oolitic in places, the grains being flattish and elliptical in shape; a few grey micaceous patches, also many small pebbles, and some larger concretions are present. This description is quite sufficient for the same bed as it exists at *Gayton*, some five miles south-west of Northampton, almost exactly on the line of strike.

At *Milton*, to the east of this line, and *Bugbrook* to the west, the bed is a little different in character. At the former place the oolitic character is not noticeable, whereas at the latter it is very pronounced; also fossils seem more abundant as we go westward, because there is less matrix.

At *Daventry*, where the bed is superficial, and *Staverton*, where it has been long exposed, the green colour is not to be observed, partly owing to oxidation and partly because at these places it is almost entirely composed of fossils. The situation of these two sections is almost exactly on the line of strike, and near the westerly limits of the Middle Lias outcrop. If the lines connecting Northampton and Gayton and Daventry and Staverton respectively be produced, it will be seen that Chalcomb lies nearly midway between them, and the bed there possesses intermediate characters.

At *Chalcomb* the bed has the same mottled appearance that it has at Northampton, though the colour is much less decided; also it is more fossiliferous, though less so than the same bed at Staverton. Some portions of the bed at Chalcomb are exceedingly pretty; they are highly vesicular, the cavities being filled in partially or entirely with calcspar, which shows up well against the other portion of the stone—red in these cases. Several good springs issue from the base of this bed hereabouts, and no doubt running water has effected the change above referred to. An experiment in the laboratory with some of the stone from Northampton showed that the green portion was mostly soluble in hydrochloric acid, with effervescence, the ochreous portions being much less soluble.

The bed near Northampton seems to be characterised by very large specimens of *Pecten liasinus*, and everywhere by small pebbles. A little iron pyrites was found in one or two specimens, which accounted for the sulphurous odour emitted when they were struck by the hammer. The thickness seems to decrease in a northerly direction but to increase eastwards. At Chalcomb it is probably 2ft., Staverton 1ft. 4in., Daventry 1ft. 3in., Northampton between 3ft. and 4ft.

FOSSILS.

Ichthyosaurus tooth (?) ... Staverton.

Fish remains, vertebræ and teeth of small fish, &c. Staverton and Northampton.

Ammonites capricornus (?) Chalcomb.
Belemnites apicurvatus ... Staverton. Some Belemnites from other places not identified.
Dentalium (?)............... Staverton.
Turbo cyclostoma .... Milton.
Eucyclus (sp. ?)............ Staverton.
Ostrea cymbium (?)........ Northampton. Other Ostrea not identified.
Pecten æquivalvis, some very large. Northampton, Milton, Daventry, Staverton.
Pecten liasinus, mostly large specimens. Northampton, Milton, Gayton, Daventry, Staverton.
Lima .... Staverton.
Limea acuticosta............ Chalcomb, Staverton, Milton.
Plicatula (sp. ?)............ Milton.
Plicatula spinosa .... Northampton, Milton.
Avicula cygnipes............ Northampton, Daventry.
Avicula inæquivalvis ...... Northampton, Milton, Daventry, Staverton.
Inoceramus (?) .... Staverton.
Modiola (sp. ?) .... Northampton.
Modiola (sp ?), *very small*. Staverton.
Macrodon (sp. ?) .... Northampton.
Macrodon (sp. ?) .... Staverton.
Protocardium truncatum .. Northampton, Milton, Staverton.
Cardita multicostata ...... Byfield.
Cardinia antiqua .... Bugbrook, Staverton, Daventry, Milton.
Cardinia lævis.. .... Northampton, Milton, Bugbrook, Staverton.
Astarte striato-sulcata...... Bugbrook, Staverton.
Gresslya intermedia ...... Northampton.
Pleuromya costata .... Daventry.
Pentacrinite .. .. Staverton.
Serpulæ .... Daventry, Staverton (very abundant).

(To be continued.)

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

(Continued from page 127.)

Finally, let us very briefly consider what was the probable origin of the Leicestershire Ironstone. At the outset we may affirm that it is impossible to suppose that the carbonate of iron contained in the Marlstone could have been deposited in the open sea in the state in which we now find it in that rock, because the carbonate, if introduced into such an area, would, on account of its strong affinity for oxygen, inevitably become converted into the peroxide. The presence, in abundance too, of mollusca in the Marlstone Rock precludes the idea of its contemporaneous deposition, for these animals could never have lived in such a concentrated solution of this iron compound as a percentage of thirty parts of the metal implies. The iron must, therefore, have been introduced subsequently to the formation of the rock. Speaking of the Cleveland ironstone, which, for all practical purposes, may be considered as identical with the Leicestershire stone, Dr. Sorby says, the calcic carbonate of many of the fossil shells it contains is often found to be partially or wholly replaced by the carbonate of iron, and the exteriors of the oolitic grains are also similarly replaced, indicating that they, too, have been altered after deposition. He concludes that the Cleveland ironstone was once an oolitic limestone interstratified with clays containing a large amount of oxide of iron and organic matter, which, by their mutual reaction, gave rise to a solution of bicarbonate of iron—that this solution percolated through the limestone, and, removing a large part of the carbonate of lime by solution, left in its place carbonate of iron (see Report Geol. and Polytech. Soc. of Yorkshire, Vol. II., 1856). With slight modification we may, I think, accept this theory as the most feasible one to account for the origin of the Leicestershire ironstone. For the *source* of the iron, however, we shall, I think, have to look beyond the beds themselves. If carbonate of iron were by any process developed in the impervious clays enclosing the Marlstone Rock, as suggested by Dr. Sorby, it would, in all probability, be deposited within those clays in the same way, for example, that it was in the clay-ironstone nodules of the coal measure shales, and, as a matter of fact, such nodules occur in the underlying Middle Lias shales. We have yet a great deal to learn as to the origin and distribution of metallic compounds in the sedimentary rocks. What the precise source of the carbonate of iron contained in the Marlstone of Leicestershire was, and when and how introduced, it is at the present time, and perhaps always will be, impossible to say.

APPENDIX, No. I.

Analysis of Middle Lias Iron Ores of Leicestershire, Oxon, and Cleveland.

	Holwell.	Eastwell Ore dried at 212°.*	Adderbury (Oxon).	Fawler (Oxon).	Tilton (h.)	Tilton (d).	Upleatham (Cleveland).	Normanby (Cleveland)
Ferric oxide	46·96	55·00	30·20	44·67	3·36	5·57	3·50	2·60
Protoxide of iron			3·40	·86	36·32	26·87	33·37	38·06
Protoxide of manganese	·45	·16		·44				
Alumina	8·37	14·98	9·10	7·85	9·60	9·00	8·10	5·92
Lime	1.17	1·20	14·8	9·29	9·70	13·00	7·55	7·77
Magnesia	1·08	·88	·7	·66	2·20	1·63	3·45	4·16
Silica	10·04	13·32	12·2	·48	10·20	13·80	14·35	10·30
Sulphur	·03	·09		tr.	·08	·07	tr.	·14
Phosphoric acid	·57	·91	·7	·55	·99	·54	1·50	1·07
Combined water and organic matter	11·49	11·55					2·80	4·45
Carbonic acid	·69	1·90	13·3	6·11	27·55	29·52	25·38	22·00
Moisture	19·02		15·6	10·31 †13·10				
	99·87	99·99	100·00	100·32	100·00	100·00	100·00	96·47
Metallic iron per centage	av. 30	33·50 av. 30	23·7	30·0	30·60	24·80	28·42	31·40

* When first got this ore contains about 25 per cent. of moisture. † Insoluble residue.

APPENDIX II.

Notes on the Palæontology of the Marlstone of Leicestershire.

With the exception of *Rhynchonella tetraedra* and *Terebratula punctata*, which are found everywhere, and in enormous numbers in the "jacks," the fossils of the Leicestershire Marlstone are neither very numerous nor greatly varied. In comparison with the Marlstone of Oxfordshire the fauna is extremely limited. Mr. Beesley, of Banbury, gives a list of upwards of 250 species from the zone of *A. spinatus* in that county; whereas for Leicestershire I am not able to mention more than a quarter of that number. Of these *A. spinatus* is rare, and except at Tilton, where we also get *A. communis*, *A. annulatus*, *A. Holandrei*, *A. Cœcilia* (?), *A. acutus*, and *A. serpentinus*, no other ammonite is to be found. The remarkable abundance of *A. acutus* in the top bed at Tilton has already been mentioned. Belemnites occur everywhere in the Rock-bed, the prevailing forms being *B. elongatus* and *B. paxillosus*. The only other *common* fossils are *Pecten æquivalvis*, *P. lunularis*, and *Lima pectinoides*. Some very interesting little Gasteropoda are to be found in the railway cutting south of Tilton Station, and also in a quarry on the east side of Pickwell, a village about three miles to the north-east. Both *Rhynchonella tetraedra* and *Terebratula punctata* show varietal forms: they also show great variations in the stage of growth of the shells, and the latter occasional monstrosities.

The general character of the Marlstone Rock, its coarse arenaceous nature and oolitic texture, the occurrence of beds largely composed of shell fragments, the presence of current-bedding, and the occurrence of drift wood indicate that it was originally a shallow water, and probably a shore (if not an estuarine) deposit. The local development of this rock is, I believe, to be explained by original limitation of deposition and not by subsequent denudation. I have already mentioned that, on lithological grounds, the Marlstone Rock can be divided into two very distinct portions—an upper calcareo-ferruginous and fossiliferous division and a lower arenaceous and much less fossiliferous division. The Rock-bed cannot be further sub-divided into zones either on palæontological grounds or by lithological characters. As a rule the "jacks," of which there may be one, two, or more, occur in the lower half of the upper or ferruginous series, but they are sometimes met with in the lower series. The "jacks" rapidly pass into ordinary compact marlstone, and cannot be identified in the different exposures.

The encrinital bands are generally found above the "jacks," but at Holwell and also at Knipton and Branston near Belvoir they occur at the base of the ferruginous series. The base of the Marlstone can always be fixed by the band of phosphatic concretions above referred to. *Ammonites acutus* and the other ammonites, *A. spinatus* only excepted, are never found except at the top, but so far these ammonites have only been found at one place, viz., Tilton. I append a list of the organic remains already known to occur in the Marlstone Rock of the Leicestershire district. The species from Tilton are placed in a separate column, from which it appears that a greater number of fossil forms have been found at that place than at all the other localities put together. Further search, especially in fresh exposures, will no doubt appreciably extend the list here given.

In drawing up this list I have received very material assistance from Mr. T. Beesley, F.C.S., of Banbury, and also from Mr. H. E. Quilter, of Leicester, who has very kindly placed a number of his fossils at my disposal. I wish also to acknowledge the valuable information that has been at different times given me by Mr. H. W. Sadler, resident engineer for the new Eaton and Eastwell branches of the Great Northern Railway, as to the character of the rocks met with on those lines; and also by Mr. W. Ingram, of Belvoir; Mr. H. A. Allport, of Barnsley; Mr. R. Dalgliesh, of Holwell; and Mr. E. E. Coke, of Nottingham, as to the history of the Leicestershire ironstone industry.

List of Fossils from the Marlstone Rock of the Leicestershire District.

	Tilton.	Other localities.
Plantæ.		
Fossil wood	×	×
Echinodermata.		
Pentacrinus lævis, Mill.	×	
,, sp.	×	×
Annelida.		
Serpula quinquesulcata, Goldf.	×	
Brachiopoda.		
Rhynchonella tetraedra, Sow.	×	×
,, ,, var. Northamptonensis	× top	
,, acuta, var. bidens, Phil. ...	×	

	Tilton.	Other localities.
Terebratula punctata, Sow.	×	×
,, ,, var. sub-punctata, Dav.	×	×
,, ,, ,, Radstockensis, Dav.	×	
,, ,, ,, Edwardsii, Dav. ...	×	×
,, ,, ,, Haversfieldensis, Dav.	?	

Lamellibranchiata.

Cardinia concinna, Sow.	×	
Monotis inæquivalvis, Sow.	×	×
Gresslya lunulata, Tate	× base	
,, intermedia, Simpson	× base	
Cardium truncatum, Sow.		×
,, substriatulum d'Orb.		×
Leda complanata, Phil.		×
Ostrea, sp.	×	×
Plicatula spinosa, Sow.	× top	×
Placunopsis, sp.	×	
Pleuromya, sp.	× base	
Pecten dentatus, Sow.	×	
,, æquivalvis, Sow.	×	×
,, priscus, Schloth.	×	
,, sublævis, Phill.		×
,, cingulatus, Goldf.		×
,, lunularis, Rom. (P. Liasinus Nyst.)...	×	×
,, textorius, Schloth.		×
Hinnites abjectus, Phil.	×	
,, tumidus, Zieten		×
Lima pectinoides, Sow.	×	×
Macrodon Buckmanni, Buck. (=Arca elongata, Quenstdt.)	×	×
Modiola scalprum, Sow.	×	×
Mytilus, sp.		×
Inoceramus substriatus, Goldf.		×
Unicardium subglobosum, Tate	×	

Gasteropoda.

Cerithium ferreum, Tate	× top	
,, confusum, Tate	× top	×
,, reticulatum		×
Actæonina Ilminsterensis, Moore		×
Eucyclus Gaudryanus, d'Orb.	× top	
Phasianella turbinata, Stoliczka	× top	×
Cryptænia expansa, Sow.	× top	×

		Tilton.	Other localities.
Trochus ariel	... ...	× top	×
,, Æolus, d'Orb.	... ...		×
Turbo Brannoviensis, Dumort.	... ...		×
,, latilabrus, Stoliczka	... ...		×
Cephalopoda.			
Nautilus truncatus, Sow.	... ...	× top	
Ammonites spinatus, Brug.	... ...	× top	×
,, communis, Sow.	... ...	× top	×
,, annulatus, Sow.	... ...	× top	
,, margaritatus, De Montf.	...	× base	
,, Holandrei, D'Orb.	... ...	× top	
,, serpentinus, Rein.	... ...	× top	
,, Cæcilia, Rein.	.. ..	× top	
,, acutus, Tate	... ...	× top	
Belemnites paxillosus, Schloth.	... ...	×	×
,, elongatus, Mill.	... ...	×	×
,, clavatus, Schloth.	... ...		×
,, apicicurvatus, Blainville	...	×	
Pisces.			
Sp. (?)—tooth	.. ..		×
Reptilia.			
Ichthyosaurus, sp.—vertebra	... ...	×	×

NOTES ON THE MYMARIDÆ.

BY F. ENOCK.

In the sixth volume of "The Entomologist," 1873, p. 498, under the above heading, is the following remark by the late Francis Walker:—"The Mymaridæ are more atom-like than all the other Hymenoptera, and thus, in comparison with them, are nearest on the surface of creation to spaceless infinity."

Many of these exquisitely beautiful "Fairy Flies" are very common, and only want to be carefully looked for to bring to light many new species, but unfortunately our knowledge of the Mymaridæ is far too small; therefore the difficulty of identifying our captures is very great. I should not have been able to give these few notes had it not been for the kindness of Mr. Ed. Fitch, Hon. Secretary of the Entomological Society, London, who named over a hundred and fifty specimens of Mymaridæ and other minute Hymenoptera for me from the various German authors. I trust that ere long some "native" will endeavour to give some account with figures of the British Mymaridæ, as no doubt there are plenty of materials in our own country to form a very good monograph.

The following is a copy of "Foerster's Synopsis," which has been very much simplified by an old friend, so that anyone can easily ascertain to which genus any specimen belongs. The numbers on the right refer to those on the left.

MYMARIDÆ.

1.	Tarsi 5-jointed	2
	„ 4 „	8
2.	Abdomen distinctly petiolated	3
	„ sessile or nearly sessile (male)	4
	„ „ „ „ (female)	6
3.	Antennæ of the male 10-jointed; female, 9-jointed—CAMPTOPTERA	
	Antennæ of the male 13-jointed; female, 11-jointed—OOCTONUS	

MALE.

4.	Marginal branch extending to the middle of the costa—LIMACIS	
	Marginal branch not extending to the middle of the costa..	5
5.	Antennæ 13-jointed .. .. GONATOCERUS	
	„ 10 „ .. .. ALAPTUS	

FEMALE.

6.	Antennæ 11-jointed .. .. GONATOCERUS	
	„ 9 „ .. .. LITUS	
	„ 8 „	7
7.	Marginal branch extending to the middle of the costa—LIMACIS	
	Marginal branch not extending to the middle of the costa—ALAPTUS	
8.	Club of the antennæ with two joints	9
	„ „ not jointed	10
9.	Marginal branch very long—Tarsi of the four hinder legs shorter than the tibiæ .. .. EUSTOCHUS	
	Marginal branch very short—Tarsi of the four hinder legs longer than the tibiæ .. .. DORICLYTUS	
10.	Abdomen distinctly petiolated	11
	„ sessile or nearly sessile	14
11.	Fore wings only widened at the tip .. .. MYMAR	
	„ „ „ throughout	12
12.	Marginal branch punctiform .. .. .. COSMOCOMA	
	„ „ elongated	13

13. Metathorax with two keels, antennæ of female 9-jointed— CARAPHRACTUS
Metathorax not keeled, antennæ of male 10-jointed; female, 9-jointed .. .. STICHOTHRIX

14. Antennæ of the male 12-jointed; female, 9-jointed, marginal branch elongated, somewhat thickened near the tip— ANAPHES
Antennæ of the male 13-jointed; female, 9-jointed, marginal branch linear, *not* thickened near the tip ... ANAGRUS

My first acquaintance with the Mymaridæ was made at Holloway, London, where, in the garden, surrounded by the usual "cats' highway" (a four foot wall) I used to find Anaphes and Anagrus tolerably plentiful on hot sunny days. I have seen them flying, and have caught them in my hand; though more frequently they were entangled in the webs of the Garden Spider, *Epeira diadema*, but far too small for that individual to notice. It was in a very dirty web that I first found the long-sought-for gem *Mymar pulchellus*, so no one living in town need despair of being able to find some of the Mymaridæ.

During the latter end of the summer of 1884 I obtained a large number of various species, representing the following genera, viz.:—Anaphes, Anagrus, Alaptus, Camptoptera, Cosmocoma, Gonatocerus, Litus, Mymar, and Ooctonus. The first to appear was *Anaphes punctum*, which I found in June—flying, on various shrubs, walking about window panes, besides sweeping them from low herbage in fields and on banks. This is one of the strongest built, its black colour enabling it to be easily seen on windows, as it runs steadily up and across until it meets with some obstacle, when it immediatly hops off (I can scarcely call it flying) a short distance. The delicate yellow *Anagrus* moves along in the most graceful manner, its long fringed wings just sweeping the glass, and when needful altering its direction by a most fairy-like turn of its train; when disturbed it quietly, and apparently with some difficulty, disengages its wings one from the other, then it takes a short flight, settling upon the glass again like a tiny speck of dust.

Alaptus is the smallest, therefore the most difficult to see, rendered still more so by its habit of not putting in an appearance until September, and seldom before half-past four or five o'clock; it has a most peculiar jerky gait, walking for about an inch-and-a-half; then off at an angle or back again for the same distance.

Camptoptera too appears in September, and, like Alaptus, seems to prefer the waning light of day before taking its walks abroad on the panes of a greenhouse, which is one of the best places to look for these "Fairy Flies," and I would recommend some of those "arm-chair collectors," who cannot possibly take so much exertion as is necessary to bend their back or legs to run after an insect, to take their seat at the end of the greenhouse, and if not too lazy to raise their eyes they will, in the course of an hour or two, see enough insect life on the glass to occupy their thoughts for a long time. But I am wandering away from *Camptoptera*, which is one of the most gracefully built of all the Mymaridæ, the head, thorax, and abdomen being beautifully shaped, the wings too are arched in a line of beauty and grace with long fringes of hair or setæ on the margins, and its step is indeed light as a fairy.

Cosmocoma contains some of the largest species of the family, the wings paddle shaped with long setæ especially along the outer margin, and one, the name of which I am unable to certify, has these long setæ on both sides of the upper wings as well as along the margins, thus resembling a bottle brush. *Gonatocerus* and *Ooctonus* are about the plainest fairies, but nevertheless beautiful.

Litus, when seen crawling up the glass, looks much like a very minute flea; it has a decidedly heavy body, but the wings are very narrow and delicately fringed. I have left *Mymar pulchellus* until last, as it is one of the most extraordinary insects I have ever met with, the anterior wings are almost the exact shape of a battledore or lawn tennis bat, the posterior being but short bristles, with a few hooklets which hook into the groove in the anterior wings, and when this insect is examined under the microscope we cannot help being struck with the marvellous arrangement of this under wing which so supports and "ties in" the long rib of the anterior one, thus preventing it from unduly bending.

I have often been asked "Where do you get these things from," and I can only add that they are to be found almost everywhere if looked for; since I have devoted some little time to the study of them, I am almost afraid to tread upon a lawn, knowing that each step taken crushes the life out of many of these most marvellous atoms, for no doubt a great many are parasitic upon the various dipterous and other larvæ feeding in the stems and upon grasses and other low herbage, whilst others keep down the swarms of Aphides. Still more wonderful, some of them search for the eggs of Lepidoptera, which they pierce with their minute ovipositor, then transmit one egg or more of their own, the young larvæ feeding upon the fluids contained in the butterfly's egg until they are full fed, when they assume the pupa state, and when fully matured the perfect fly eats its way through the shell of the butterfly's egg, emerging into light and freedom.

Sir John Lubbock mentions in the "Linnæan Transactions," Vol. 24, p. 142, having found one species, which he named *Prestwichia aquatica*, as using its wings to enable it to swim under water. This one lays its eggs within those of a dragon fly.

It is a curious fact that in most cases the females are far more plentiful than the males, as the following list will prove, taken from my journal for the past three years :—

	Males.	Females.
Anagrus	6	41
Anaphes	55	40
Mymar	1	4
Litus	0	12
Cosmocoma	2	5
Alaptus	3	24
Camptoptera	0	110
Gonatocerus	5	10
Ooctonus	1	5

I cannot in any way account for the extraordinary difference in Camptoptera; in fact, I could not believe all were females until I had most carefully counted the joints of the antennæ, and even the setæ around the wings; but I was obliged to own I had never captured a male, though I searched for them at all hours, in all sorts of places, and in all sorts of weather. I never saw the ghost of one until Mr. Gooch, of Eton, very kindly sent some specimens of Mymaridæ for my examination, amongst them two Camptoptera, one of which was a male.

Beside the above representatives, I have two species which I have utterly failed to identify as belonging to any of the genera mentioned in "Foerster's Synopsis;" no doubt they will prove additions to this most interesting family, many of which do not measure more than one-fiftieth of an inch from head to tail, and yet within this compass is contained the complete organism of a perfect insect, almost too wonderful for our minds to grasp.

"Then sweet to muse upon his skill displayed,
(Infinite skill) in all that he has made!
To trace in Nature's most minute design
The signature and stamp of pow'r divine,
Contrivance intricate, express'd with ease;
Where unassisted sight no beauty sees,
The shapely limb and lubricated joint,
Within the small dimensions of a point.
Muscle and nerve miraculously spun,
His mighty work who speaks and it is done.
Th' invisible in things scarce seen reveal'd,
To whom an atom is an ample field."—*Cowper.*

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(Continued from page 135.)

In the Orton boring even the Trias was absent, and the Lower Lias reposed on a quartz-felsite which was penetrated to a depth of seventy-four feet. This rock appears to me* identical with the quartz-felsite of the Caldicote pit (Nuneaton). Its position—twenty-five miles south-east of Charnwood—shows a much greater extension of the line of upheaval marked by the anticlinals of Charnwood and Hartshill than was previously known. At Rugby the boring was clearly in a filled-up valley, for although several hundred feet of red marls and sandstones were passed through (underlying an equal thickness of Lias), yet the boring terminated in the Upper Trias. A good supply of water was obtained, but it was so salt as to be unfit for domestic use.

The Sapcote boring in South Leicestershire was commenced in 1868. After passing through 540 feet of Triassic marls and sandstones the boring tool reached indurated shaly and slaty beds of a dark colour, much jointed, and dipping at a very high angle; a total depth of 1,655 feet was obtained. I believe these beds to represent part of the Stockingford Shales, and therefore to be of Cambrian age. Mr. Bosworth, by whom the Sapcote boring was executed, speaks of the shales of the Stockingford cutting (at a time when the latter were thought to be Coal-Measures), as "similar to those at Sapcote." He also refers to the Sapcote cores as "precisely similar to those found at Evington."

The three borings next in order—those commencing in the Rhætics and Lower Lias on the east side of the town of Leicester—were executed between 1876 and 1880. At the first boring, on the eastern foot of the Spinney Hills, a bed of running sand was met with in the Trias at a depth of 750 feet, and the difficulties were so great that the boring was abandoned at this point. At the next attempt old rocks were reached at a depth of 728 feet, and the boring was discontinued at 819 feet. The third boring, a mile further east, reached similar strata at 836 feet, and ended at 1,002 feet. The bottom rocks in these two bore-holes were dark-blue, much jointed, coarse, indurated shales or slates, just like what the Stockingford shales would be when unweathered. No fossils were

* I have examined the cores from most of the borings given in the table.

detected in them, but they may be assigned with much probability to the Cambrian period. The Owthorpe boring, six or seven miles south of Nottingham, passed through sixty-six feet of Lower Lias and Rhætic beds, and 1,000 feet of the Trias, below which the coal-measures were found.

At South Scarle, between Newark and Lincoln, the Trias occurred in full force. The section here gives

	Feet.		Feet.
Drift	10	Keuper Waterstones	244
Lower Lias	65	Bunter Sandstone	542
Rhætic Beds	66	Permian Beds	519
Keuper Marls	573	Coal-Measures ?	10

The pebble-beds of the Bunter were here entirely wanting. At a depth of 2,019 feet deep red indurated marls with nodules of hæmatite were found, which are believed to be upper coal-measures.

Of borings east or west of the line which we have now described, only two or three need be mentioned. On the east, at Harwich, the Gault was found to rest—at a depth of 1,030 feet—upon dark slaty rocks, which the presence of a *Posidonia* proved to be of Lower Carboniferous age.

On the west, two or three borings were put down in the neighbourhood of Market Bosworth, in West Leicestershire, between 1878 and 1880. These proved that the coal-measures do not extend uninterruptedly beneath the new red marls as was originally supposed. Indurated and jointed shales varying in colour from red or purple to blue or grey (probably the Stockingford Shales) were found and pierced to a considerable depth without being bottomed. At Burford, near Oxford, a considerable thickness of the Trias was found to rest upon coal-measures, which were reached at a depth of 1,184 feet.

The cores brought up from these borings in many cases show clearly the dip of the old rocks—usually at a considerable angle, 80 degrees or more—but unfortunately we are unable to determine from them the direction of the dip, for the cores are of necessity moved and, perhaps, rotated many times before they can be brought to the surface. By letting down a compass which could be fixed to the top of the core, and then fixing the direction of the needle by means of a stop, actuated by an electric current, it would seem to be possible to find out this important point.

It is most desirable that the borings which have been made should be supplemented by others, put down at points selected by a committee of those geologists who have specially studied the subject. The expenses might be defrayed partly by Government, partly by a rate (voluntary or otherwise) levied upon the landowners of the district.

As the coal supply diminishes from the exhaustion of the present proved areas, such experimental borings will doubtless be undertaken.

Relations of the Post-Silurian strata to the Midland Axis.— There is no evidence of the extension of the Old Red Sandstone to the east of the Severn. Whether it was formed in a lake, or in a delta, it is probable that it was pretty well confined to the region where it is now exposed. The Carboniferous rocks thin from north to south in the most marked manner as they approach the Charnwood-Longmynd line. There is a thin impure representative of the mountain limestone on the north-west flank of Charnwood, but even this is absent (together with the millstone grit) in Warwickshire and Staffordshire. It is true that the Northampton borings yielded fossils of this age, but they were from sandstones and marls, the shallow water representatives of the grand 3,000 feet thick deep-sea limestone of Derbyshire.

The manner in which the South Staffordshire coal-measures rise up and terminate against a sub-terrestrial ridge of Silurian rocks on the south of Halesowen has already been described.

Of the succeeding Permian strata, we find that in Notts. the Magnesian Limestone (Lower Permian) decreases from above 100 feet at Shireoaks to 30 feet at Bulwell; showing that as we pass southwards we are approaching its ancient limit or shore-line, the region round Charnwood Forest. Westward, in South Staffordshire and Shropshire, the Permians are thicker, but they show every sign of the presence of land immediately to the south during the time of their formation. South of the line of the ancient axis we get no indications of Permian strata; they are wanting in all the borings made in this direction, and they nowhere occur at the surface.

The Triassic Formation, above 3,000 feet thick in Cheshire, and possibly of equal thickness in Yorkshire and Durham, thins away steadily (the lower beds disappearing first) to the south. The Bunter Pebble Beds barely reach to Leicestershire; their thickness decreasing from above 300 feet in Cannock Chase to a mere band of 10 feet in the railway-cutting at Gresley in north-west Leicestershire, and the borings further south show only a small thickness of the "red rocks," and that of a littoral nature, between Northampton and London. Between the Malvern and the Mendip Hills the Bunter Beds (Lower Trias) are absent, and a thin layer of the Keuper, evidently a shore deposit, rests on Devonian and Carboniferous rocks.

The Jurassic System has an uninterrupted outcrop from Dorset to Yorkshire, crossing the old land, and probably filling up one of its valleys, near Northampton. But neither Liassic nor Oolitic strata have any eastward extension, for the borings prove their absence, except in the most fragmentary form, between Ware and Richmond.

Fragments of the Pre-Carboniferous Floor contained in newer rocks.—The Carboniferous strata of the Midlands contain but few rock-fragments or pebbles of the formations upon which they rest. This is not a matter of surprise when we remember that the mountain limestone is a deep-water formation, whose actual junction with its southern shore-line is nowhere exposed, although we approach within a hundred yards or so of it at Gracedieu, on Charnwood Forest.*

The Millstone Grit of Stanton Harold and Ticknall (N.W. Leicestershire) is only 200 feet thick, and contains a quartzitic conglomerate. Much of the rock may be termed "arkose," the cemented felspar and quartz crystals of which it is composed having suffered very little wear.

The coal-measure shales must have been deposited in very quiet waters—perhaps in the swamps and deltas of the many mouths of a mighty river like the Amazon or the Mississippi. No bare rocky ledges or abrupt sea-cliffs existed along the shore-line to furnish shingle beaches, but monotonous flats, formed perchance by the Silurian shales.

In Leicestershire the Permians exist only as thin patches of breccia, consisting of green slates, grits, quartzites, and greenstones, some of which are polished and striated. The so-called Permians of the Warwickshire coal-field I believe to be largely upper coal-measures.

In Staffordshire the Permians of the Clent Hills are so charged with rock-fragments that these heights were formerly thought to consist of solid trappean rock. Near Northfield the same strata are crowded with angular blocks of Silurian limestone and sandstone, quartzite, &c., so that Prof. Jukes (who surveyed the district) was compelled to the belief that "a boss, or peak, or ridge of the Silurian sandstone lies concealed under the Permian rocks somewhere close by."†

In Shropshire the Permian breccias of Alberbury west of Shrewsbury, consisting of angular fragments of Silurian and Lower Carboniferous rocks, are no less than 400 feet thick.

* The actual junction is here hidden by a patch of Triassic sandstone, which rests unconformably on the edges of the Forest rocks and the limestone.

† Geol. S. Staff. Coal-field, p. 9.

But it is in the Trias that evidences of the proximity of land become most numerous and most striking. Breccias and pebble beds occur on two distinct horizons in the Triassic series—(*a*) in the Bunter Conglomerate, and (*b*) in the Keuper Basement Breccia.

(*To be continued.*)

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(*Continued from page 123.*)

In Animals partaking of the nature of two classes, the ear is still a constant mark of difference. The Ornithorhynchus and other Monotremata, for example, possess the columella of a bird; whilst the whale and other Cetacea have a peculiar ichthyic-mammalian ear. The whale, for example, would seem to hear, as it were, backwards, for the eustachian tube opens into the blow-hole, and the external orifice is nearly closed. The petrotympanic bone acts as a true otolith, whilst the mammalian ossicula (small ear bones) and tympanic membrane are also present. When, therefore, the cetacean comes to the surface for air, it is able to hear aërial vibrations through the medium of the eustachian tube, the while the otolithic ear is immersed, and cognisant of aquatic sounds.

It is in the mammalian ear that we reach the highest perfection. The external ear is now added (very motile in the lower animals, and to some extent also in certain men, especially savages), possessing a suite of muscles, and every appliance for the discrimination of the faintest sounds.

The cochlea, which we found commencing in reptiles, is here very complex, enabling the mammal to distinguish delicate shades of tone. The tympanic membrane is also fully exposed to aërial vibrations, whilst the columella is replaced by a chain of exquisite ossicles, connecting, as the columella does in birds and reptiles, the tympanic membrane with the covering of the fenestra ovalis, which communicates with the internal ear.

Taking the human as our type of the mammalian ear, we may describe it as consisting of three parts—the external, middle, and internal ear (or labyrinth).

The *External Ear* includes the visible part called the Auricle or Pinna and the passage leading to the membrane of the drum. The auricle consists of one piece of cartilage having divisions scattered throughout it, and penetrating nearly through its thickness, thus giving to it great flexibility. It is attached to and moved upon the head by three sets of muscles—anterior (*attrahens*), superior (*attollens*), and posterior (*retrahens*). It possesses also several intrinsic muscles, which in man are feeble and scarcely distinguishable, seeming to be merely rudimental of those more highly developed muscles found in the large ears of most quadrupeds, enabling them to alter the form and direction of the auricle. The divisions of the Pinna are (1) the Helix, or outer rim; (2) the Anti-helix, parallel with it; (3) the Concha, or deep depression which focusses and reflects sound vibrations; (4) the Notch, or lowest part of the concha; (5) the Tragus, on the cheek side of the notch; (6) the Anti Tragus; and (7) the Lobe, or soft pendulous part below the notch. The canal (*Meatus Externus*) opening to the Drum is about an inch to an inch and a-half long—shortest in childhood, when the inner or *bony portion* of the meatus is wanting, being represented by a mere tympanic ring. Its direction is curved, and slightly tortuous, convex above, and oval in section. It is closed internally by the nearly circular membrane of the drum, which is inclined outwardly at an angle of about 45deg. with the floor of the canal. The canal is lined in its external part with fine hairs, and studded with ceruminous glands, most numerous about the centre. These glands secrete the Cerumen or ear wax, which serves partly for cleansing the passage, and partly perhaps, by its intensely bitter taste, to keep out insects.

The *Middle Ear* or Tympanum is the irregular space between the tympanic membrane and the internal ear. It measures about ¼in. from the membrana tympani to the vestibule, and about ½in. in its other two diameters. The tympanic membrane is fitted into a groove in a ring of bone, which is said to assist in conveying to the membrane sound vibrations communicated through the cranial bones. The membrane is thin and semi-transparent, but consists of three layers—an outer layer continuous with the cuticle of the external meatus—an inner layer continuous with the mucous membrane of the tympanum, and a middle layer of fibrous tissue on which its strength depends, very elastic and containing blood vessels and nerves. Its fibres are chiefly radial, but there appear to be a few circular ones near the outer edge. The roof of the tympanum communicates posteriorly with a number of air cavities (the mastoid cells in the mastoid process of the temporal bone). In the floor is the opening of the eustachian tube, a narrow canal about an inch and a half long, enlarged at both ends, especially at its nasal end, where it forms a trumpet-like dilatable opening on the side of the pharynx just behind and above the soft palate (*velum*) and tonsil. The use of the tube is to preserve an equilibrium between the air within and without the tympanum, and to sweep away, by means of its cilia, the mucus secreted in the cavity of the tympanum and by its own walls. The outer air is constantly varying in density, and, were the drum a closed chamber, the membrane would be liable to strain from without with each increase in density of the outer air, and from within with each decrease. The sense of pain felt in the ears when going up in a balloon or down in a diving bell, and sometimes also after vigorously blowing the nose, is relieved by repeated swallowing, which act dilates the pharyngeal end of the tube for the admission of air from the mouth and nose, thereby equalising the density of the tympanic and external air.

(To be continued.)

RORAIMA MOUNTAIN.*

BY W. P. MARSHALL.

Roraima is a remarkable mountain in South America that has just been ascended for the first time by a special traveller and botanist, who have obtained some very interesting results. The mountain is in British Guiana, near the middle of the northern coast of South America, about 200 miles distant from the coast and close to the boundaries of Brazil on the south, and Venezuela on the west. British Guiana is a state about equal in size to England, containing several ranges of mountains of moderate heights (about the height of those in Great Britain); but one mountain, Roraima, the highest of them, is 6,000 feet high, or half as high again as Ben Nevis, our highest mountain. The country is tropical, being within five degrees of the equator, and is a specially rich orchid region; the approach to the mountain is difficult, and is described as "four days' walking through a purely savannah but most glorious country, and over splendid mountain passes, leading to an inconceivably magnificent valley on the southern slope of Roraima."

* Transactions of the Birmingham Natural History and Microscopical Society.

The mountain is of a very singular and unique form; the base rises with a gradual slope all round of about 1,500 feet height, and the mountain then suddenly shoots up with nearly vertical cliffs several hundred feet high to the full height of 6,000 feet above the sea; these vertical cliffs extending all round, and making the mountain exceptionally difficult of ascent. The ascent has now been made by Mr. Everard F. Im Thurm, who was sent out jointly by the Royal Society and the Royal Geographical Society, and was accompaied by Dr. Siedel, a German orchid collector; this ascent of Roraima has been a cherished object of botanical exploration in South America for the last quarter of a century.

The ascent, though laborious, was not dangerous, but in order to make the ascent of the latter steep portion, "the travellers were compelled to climb trees and to leap from rock to rock." The top of the slope is described as "a most beautiful spot, a very garden of orchids and most beautiful and strange plants," and "when they ultimately reached the summit they were surprised to find that it consisted of a broad plateau, twelve miles in length by four in breadth, on which they discovered some forms of vegetation previously unknown to science, and a vast number of fantastically-shaped rocks." Mr. Im Thurm states—"The vegetation on the top was most wonderful, but somewhat scanty and quite dwarf. I have, I believe, 300 to 400 species; also some living plants, including Heliamphora and three most exquisite Utricularias, two of which are I fancy new." It has hitherto been assumed that the mountain was crowned with trees, whereas they could find nothing of larger growth than shrubs about three feet high. Another delusion which has also been dissipated is that the loftier altitudes of Roraima sheltered strange animals; but these existed only in the imagination of Indians, for, with the exception of a few butterflies, the travellers saw no trace of animal life. All the explorers of British Guiana refer to the cascades that abound on the sides of the mountain; and these, it appears, are fed from numerous pools of water on the top plateau, the view from which is described as being of surpassing grandeur. Mr. Im Thurm by his achievement has added another page to the history of successful geographical research, and has fully justified the support he has received from the Royal Geographical Society. He started on his exploration on 16th October last, made the ascent of the mountain on December 3rd, and reached George Town, the port of British Guiana, on his return journey on January 31st.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The EIGHTH ANNUAL MEETING will be held at Birmingham on Tuesday and Wednesday, the 16th and 17th June instant.

PROGRAMME FOR TUESDAY.

The ANNUAL MEETING will be held in the Examination Hall, Mason College, Birmingham, on Tuesday, June 16th, at 3.15 p.m., the President of the Union (Mr. R. W. Chase) in the Chair. The business of the Meeting will be to receive the Report of the Council and the Treasurer's Accounts; to fix the place of the next Annual Meeting in 1886; to award the Darwin Medal for the year 1885; to consider any suggestions that Members may offer; to discuss the work of the Union during the coming year; and to transact all necessary business. The President will open the Meeting with an Address.

RECEPTION ROOM.—A Reception Room will be provided at the Society's Library, Mason College, for members of the Union and other visitors, and letters may be addressed there. An arrival book will lie on the table, and it is hoped that all visitors will enter their names and temporary addresses in it, for the information of friends who may desire to communicate with them. The same room will also serve as a news room, and will be supplied with newspapers.

CONVERSAZIONE.—A Conversazione will be held, by permission of the Mayor (Ald. Martineau), in the Town Hall, Birmingham, on Tuesday Evening, June 16th. There will be an Exhibition of Objects of general Scientific Interest, Microscopy, various departments of Natural History, Art, and Archæology. Members of Societies in the Union and friends willing to contribute specimens, or to exhibit or lend microscopes, will oblige by at once communicating with Mr. J. Morley, Society's Room, Mason College, Birmingham. At intervals a selection of music will be performed upon the grand organ by Mr. Stimpson. The charge for admission to the Conversazione will be 2s. 6d. Doors open at half-past seven. Morning Dress. Carriages may be ordered for half-past ten. Tickets are now ready, and can be obtained by members for themselves, and for friends not members of the Union, through any of the Secretaries of the Societies in the Union, or direct from Mr. J. Morley, Mason College, Birmingham.

PROGRAMME FOR WEDNESDAY.

EXCURSIONS.—On Wednesday, June 17th, there will be three Excursions, viz.: to Coventry and Kenilworth; to Cannock Chase; and to The Lickey.

Coventry and Kenilworth.—The train will leave Birmingham (New Street) at 9.40, arriving at Coventry at 10.11. The party will be met at the station by Mr. W. G. Fretton, F.S.A., who will conduct the members to the following places of interest in the city: Site of Cheylesmore Manor House, Grey Friars Spire, now attached to Christ Church; all that remains of the Franciscan Monastery, Ford's Hospital, a magnificent specimen of timber work; St. Michael's Church, St. Mary's Hall, Holy Trinity Church, Remains of the Benedictine Priory and Cathedral, Remains of City Walls and Gates, St. John's Hospital, now the Free Grammar School, Batlake Hospital, and St. John's Church, to Craven Arms Hotel to lunch at 12 o'clock.

Leave for Kenilworth in conveyances at 1 o'clock, viâ Stivichall, Avenues of Oak, along the Warwick Road. Turn off at Gibbet Hill for Stoneleigh, Ancient Church, Motslow Hill, the Abbey, and Thickthorne Woods, to Kenilworth Castle. Mr. Fretton will describe the ruins and conduct the party by way of the remains of the Priory and the Parish Church, to the Station.

Leave Kenilworth at 5.34; arrive in Birmingham at 6.10; Meat Tea at Grand Hotel at 6.20. Tickets 12/- each, or without Meat Tea 10/-.

Cannock Chase.—The train will leave Birmingham (New Street Station) at 9 20, arriving at Brownhills at 10 10; proceed by Cannock Chase Colliery Company's engine up their line of railway and visit their collieries; proceed to the Cannock and Rugeley Collieries, look over the surface arrangements at Cannock Wood Pits, and those persons who are so disposed can descend the various pits. Luncheon will be provided at the Anglers' Hotel, Hednesford, at 2 30. After luncheon, visit the Cannock and Rugeley Company's Pool Pits and the Hednesford Canal Wharfs. Leave Hednesford Station at 4 55, arriving in Birmingham at 6 15. Tickets, 8s. each. Meat tea at the Grand Hotel, at 6 20. Tickets, 2s. 6d. each.

The Lower Lickey Hills.—For Geologists, Photographers, Botanists, &c.—Leave Snow Hill Station (Great Western) by 10 a.m. train, arriving at Rubery 10 51. Examine coal measures and Upper Silurian rocks in the Asylum Grounds, with the basement bed—Llandovery Sandstone resting on an eroded surface of Quartzite. Study the Quartzite in the grand section at the railway station (Rubery), and in numerous fine sections between that point and Barnt Green. Walk to Kendal End, where the Wenlock Limestone and brecciated rocks are exposed, and trace the sequence down to the Quartzite (which is of either Cambrian or Pre-Cambrian age) and to the rocks which, at the southern end of the Lickey, lie beneath the Quartzite—volcanic ashes unquestionably of Pre-Cambrian age. The last-named strata are exposed in the brook-course near Kendal End. Numerous fine boulders of Welsh felstone are scattered over this region. Distance to be walked, about four or five miles. Return by 5 20 train (Midland) from Barnt Green, arriving in Birmingham (New Street Station) at 6 p.m.; Tea at the Grand Hotel at 6 20. Tickets 5s. each, or 3s. without Meat Tea. A call will be made at the "New Rose and Crown Inn," where light refreshments may be obtained.

Tickets must be applied for not later than Monday, June 15th, and may be procured from Mr. J. Morley or Mr. T. Bolton, Society's Room, Mason College, Birmingham, between twelve and three o'clock, or by post.

METEOROLOGICAL NOTES.—April, 1885.

The barometer was rising at the commencement of the month, but fell from the 3rd to the 6th, and thence rose gradually to the 19th, when it reached its highest point, 30·328 inches; it again fell rather rapidly to the 26th, and continued unsteady. Temperature was low until the 17th, when the maximum was 64·7°, as against 43·9° the previous day. The mean was about one degree below the average. The highest readings were 71·5° on the 19th and 71·4° on the 21st at Loughborough; 71·1° at Hodsock, on the 21st; 70·0° at Henley-in-Arden, on the 19th; 69·9° at Coston Rectory, and 69·8° at Strelley, on the 21st. These maxima are unusually high for the month of April. In the rays of the sun, 126·7° was recorded at Hodsock and 123·9° at Loughborough, on the 21st; 123·6° at Strelley, on the 20th. The minimum readings were lower than usual: 20·7° at Hodsock and 22·0° at Coston Rectory, on the 14th; 23·0° at Henley-in-Arden and 23·6° at Loughborough, on the 5th; 27·0° at Strelley, on the 4th and 5th. On the grass, 15·0° at Hodsock, on the 4th; 17·5° at Loughborough, on the 5th; 17·7° at Strelley, on the 2nd. Rainfall was rather above the average, the totals varying from 1·94 to 1·47 inches, and the number of "rainy days" from 16 to 13. The greatest fall was 0·56 inch, which was the value at Loughborough and Henley-in-Arden on the 1st. Sunshine was about the average. The wind was moderate in force and of variable direction. A lunar halo was observed at Loughborough on the evening of the 27th. The cuckoo was heard at the close of the month. Swallows were seen at Henley-in-Arden on the 17th.

12, Victoria Street, Loughborough. Wm. Berridge, F.R. Met. Soc.

Natural History Notes.

The Flora of the Lake District.—We are pleased to be able to announce that Messrs. Bell and Co. have just published "A Flora of the English Lake District," by J. G. Baker, F.R.S., F.L.S. This very excellent work contains a record of about fifty ferns and 850 flowering plants, native of the Lake district; together with about 100 recent additions, and valuable introductory matter relative to citizenship, the range and the type of distribution of the plants enumerated. There is also a truly interesting Bibliography of the Lakeland district. The eminent position as a botanist enjoyed by the author of this Flora ensures its being an able and correct record of the botanical wealth of one of the most classic and romantic districts in England, and will ensure for it a wide circulation among all who are interested in the study of British botany.

Sparrows *versus* Starlings.—The impudence of sparrows is proverbial, but I do not remember to have noticed until lately sparrows attending upon starlings that were collecting worms to feed their young and when opportunity occurred seizing hold of the worms and pulling them out of their beaks. It looked very ridiculous to see a starling waddling along with its insecure gait, poking its long bill here and there into the grass, and now and then a struggle for the spoils. In one instance I noticed five sparrows following, and the starling was fairly driven away. Sparrows peck away on the lawn incessantly, but I was not aware that they eat worms, as they do not pull them up as robins do. I remember that some years ago there was a controversy in the "Zoologist" as to whether starlings poked their open beaks into the turf; I agreed with my relative, the late Edward Newman, that they did, and do not see any reason to change my opinion. A thrush or a blackbird seizes hold of the worm and pulls it out by leverage, but a starling pushes his bill into the ground on either side of the worm and pulls it out or bites it off with one effort. The quantity of worms I have noticed the starlings take to their young is very great—backwards and forwards all day long. I have not noticed sparrows attack blackbirds or thrushes when collecting.—WM. SOUTHALL.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, April 28th.—The retiring President (Mr. T. H. Waller, B.A., B.Sc.) read an address, which will appear *in extenso* in the "Midland Naturalist." Mr. R. W. Chase exhibited a male specimen of *Somateria spectabilis*, the King Eider, shot at the Farne Islands, Northumberland. This bird is rarely seen in Great Britain, its home being in the Arctic regions. Mr. A. Browett exhibited the common viper or adder, *Vipera ferus*, from Bournemouth, and a flower spike of *Aponogeton distachyus*.—GENERAL MEETING, May 5th.—Mr. T. Bolton exhibited *Volvox globator*, with the rotifer *Notomata parisitica* living inside it, and *Phalansterium digitatum*, from King's Norton, an infusorian new to Great Britain. —BIOLOGICAL SECTION, May 12th. Mr. W. H. France in the chair. —Mr.J. E. Bagnall, A.L.S., exhibited and described the following:—*Taraxacum palustre*, *Cardamine amara*, and *Carex præcox* from Arbury; *Nasturtium amphibium*, *Alisma lanceolatum* from Griff; mosses, *Didymodon flexifolium*, new to Warwickshire, from Atherstone; *Eurhynchium striatum*, *E. piliferum*, *Tortula lævipila*, *Hypnum chrysophyllum*, *Fissidens exilis*, *Campylopus pyriformis*, and other mosses from the Anker basin. Also a peculiar abnormal state of one of the agarics, in which a group had been transformed or degenerated into a mass of beautiful purple filamentous threads, found growing on a block of wood in a drain in Buckingham Street. For Mr. J. T. Slatter, of Evesham, the morrel, *Morchella esculenta*, one of the esculent fungi, found near Redditch. Mr. T. Bolton, F.R.M.S., *Volvox globator*, infested with the rotifer *Notommata parasitica*; *Rhinops vitrea*, from King's Norton; and *Limnocodium Sowerbei*, the fresh-water medusa.—GENERAL MEETING, May 19. Mr. Waller exhibited a method of cleaning No. 1 microscopic glass covers. Mr. Bolton exhibited *Syncoryne frutescens*, the living hydrozoa, with the medusoid planoblasts attached and free. Mr. W. B. Grove, B.A., read a paper by Mr. Francis Fowke, F.R.M.S., on "The First Discovery of the Comma Bacillus of Cholera," accompanied by photographs, and a number of impressions of similar objects from engravings on wood. Mr. Fowke claimed that two English doctors, Messrs. Brittan and Swayne, had discovered the Bacillus of Cholera during the epidemic of 1849, and figured it in a journal of that time. Mr. Grove regretted that he was unable to agree with Mr. Fowke in according to the English observers the right of priority. The sketches given by them bear no indication of their scale, but, making a guess at that from the other particulars given, it will be seen that they represent objects much larger than the Bacillus; moreover, the drawings do not in any case resemble the Bacillus, which never forms rings, and, when septate, is widely different from the only figure they give in which the septa are shown.—SOCIOLOGICAL SECTION, May 7th. The President, Mr. W. R. Hughes, F.L.S., read Chapters IV. and V. of Mr. Herbert Spencer's "Study of Sociology," viz., on the "Difficulties of the Social Science" and "Objective Difficulties," interspersed at intervals with valuable disquisitions and instructive explanations, to which all present contributed. May 21. Mr. W. R. Hughes, F.L.S., in the chair. Miss Naden ably read and expounded Chapters XI. and XII. "Direct equilibration" and "Indirect equilibration" of the 3rd part of Mr. Herbert Spencer's "Principles of Biology." A very interesting discussion on the many intricate biological problems introduced, followed the paper, in which the President, Dr. Hiepe, Mr. W. H. France, Mr. F. A. Walton, and Miss Naden took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 20th. Mr. J. W. Neville showed various specimens of helices from Spain; Mr. Madison, a singularly distorted specimen of *Clausilia rugosa* from Hamstead; Mr. Deakin, a pair of Emperor Moths and eggs of the same. Under the microscope, Mr. Moore exhibited stomach, malpighian tubes, &c., of *Pulex irritans*; Mr. J. W. Neville, *Volvox globator*, A paper was then read on practical microscopy, "Mounting in Glycerine," by Mr. H. Insley, which described the advantages of glycerine as a mounting medium more particularly for botanical objects, and also some of the difficulties attending the use of glycerine jelly and Deane's gelatine. The process of preparation was then shown and the mode of securely sealing the cover glass described.—April 27th. Mr. Tylar exhibited specimens of silver ore from Utah; Mr. Madison, a collection of caddis cases typical of the district; Mr. Hawkes, specimens of a fungus *Peziza cyathoidea*. Under the microscope, Mr. Moore showed lancet and suctorial organ of *Pulex irritans*; Mr. J. W. Neville, palate of *Nassa reticulata*.—May 4th. Mr. Moore exhibited specimens of *Paludina contecta*, and *Helix rotundata* var. *alba*, the latter from Great Barr; Mr. Hawkes, the following fungi:—*Puccinia Saxifragarum*, *P. Ægopodii*, and *Æcidium ranunculacearum*. Under the microscope, Mr. Dunn showed eggs of cypris; Mr. J. W. Neville, mouth organs of mosquito; Mr. Hawkes, slides of entomostraca, desmids, and diatoms from the digestive organs of small fish.—May 11th. Mr. Madison showed a number of distorted specimens of *Limnæa peregra* from near King's Norton. Under the microscope, Mr. Moore, hair of white mole; Mr. Beale, eggs of *Gobius niger*, with advanced embryo; Mr. Hawkes, the buttercup mite, *Bryobia haustor*.—May 18th; Special—Geology. A large collection of carboniferous fossils was placed upon the table, made by the members in the Bentley district during an excursion on the previous Saturday afternoon. Mr. Insley showed polished specimens of *Favosites gothlandica*, and a slab of Lower Lias containing fish remains, the latter from Lyme Regis; Mr. Madison, large specimens of *Unio tumidus*, and some varieties of *Anodonta anatina*; Mr. Hopkins, a white variety of *Limnæa stagnalis* from Barnt Green. Under the microscopes, Mr. Moore showed sections of Devonshire corals; Mr. J. W. Neville, section of *Heliolites interstinctus*; Mr. Hawkes, *Draparnaldia tenuis*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. —MONTHLY MEETING, Wednesday, May 20th. Attendance, ten (one lady). Election of officers for the ensuing year: Chairman, F. T. Mott; Hon. Secretary, C. W. Cooper, M.D., in the place of Mr. J. H. Garnar, who desired to resign, to the great regret of the Section, by whom his valuable services for the past two years were much appreciated. The Chairman reported that at the Field Day on the previous

Wednesday five members went to Kirby Muxloe, examining the ruins of the castle and surrounding district, and two others visited Syston for the purpose of procuring a number of specimens of *Petasites vulgaris*. At Kirby were found *Lilium martagon*, *Polygonum Bistorta*, *Vinca minor*, *Myosotis collina*, &c., growing in various parts of the old inclosure and about the ruined walls; several of them perhaps relics of a garden all traces of which are now lost under a uniform green turf. Rooted in the foundations of what was once a wall, and hanging far over the weedy moat, was a large bush of *Cornus mascula*, with a stem three or four inches in diameter, and the branches loaded with the curious umbels of young fruit. This shrub is not a native of Britain, but was introduced from Europe about three hundred years ago, and is described and figured by Parkinson in his "Theatrum Botanicum," published in 1640. This also is probably a descendant of what was planted long ago as a choice novelty. On the banks of the moat were *Lunularia vulgaris*, *Neckera complanata*, *Barbula fallax*, and other hepaticæ and mosses. The party who went to Syston brought back a number of flower-spikes of *Petasites*, all of which proved to be the sub-male form. The sub-female, however, which is said to be comparatively rare, has been found in several districts of the county. The Evening Meeting was devoted to the exhibition of specimens and to general discussion; there was no paper. The following objects were exhibited:—By Dr. Finch, several admirable slides of the Bacilli of Anthrax and Tuberculosis, mounted by Dr. Buck, and well shown by Mr. Garnar, with a power of about eight hundred; by Mr. E. F. Cooper, F.L.S., slides of the male and female flowers of *Petasites vulgaris*, and a specimen of the rare *Lamium intermedium*, new to this county; by Mr. W. A. Vice, fruits of *Liriodendron*, *Catalpa*, *Juglans nigra*, *Laurus Sassafras*, *Platanus*, &c.; a bunch of the remarkable epiphyte, *Tillandsia usneoidea*, from the West Indies, looking like a mass of tangled twine; two kinds of American oak-galls, one a single cell, the other an aggregate of cells; and specimen plates of Mr. F. W. Kirby's new Text Book of Entomology, published by Swan Sonnenschein and Co., which was particularly interesting to the members, Mr. Kirby being a Leicester man; by Mr. W. E. Grundy, capsules of the cotton plant, *Gossypium;* ripe fruit of the castor oil plant, *Ricinus communis;* and well mounted slides of the peristome of *Mnium hornum*, and several algæ; by the Chairman, fresh flowers of the curious umbellifer, *Dondia Epipactis;* the summer snow-flake, *Leucojum æstivum;* and the wild cowslip grown in good garden soil, showing the large clusters of flowers and the tendency to proliferous growth which is a common effect of cultivation on this plant; dried specimens of the large common sea weeds *Fucus vesiculosus*, *serratus*, and *nodosus; Laminaria saccharina* and *digitata;* also of *Polysiphonia fastigiata*, showing under the microscope the peculiar and elegant structure of this genus; and the floating gulf weeds *Sargassum vulgare* and *bacciferum*; also a series of marine shells, *Oliva*, *Conus*, *Murex*, *Trochus*, *Cerithium*, *Cypræa*, &c., showing the characters which distinguish mature from young shells, the marks indicating periods of growth, the peculiar nature of porcellanous shells, and the difference between the entire mouth of the herbivorous species and the canaliculated mouth of the carnivorous ones. The Society having decided to apply under the new rules of the British Association for recognition as a Corresponding Society, the Chairman urged upon the members of the section the necessity of earnest work, especially upon local zoology and botany, in order to maintain the position and reputation of the Society.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT BIRMINGHAM, JUNE 16TH, 1885.

ADDRESS BY MR. R. W. CHASE, PRESIDENT OF THE UNION.

At the annual meeting of the Midland Union of Natural History Societies it is the not unpleasing duty of the President to deliver an address. Considering the somewhat festive character of our annual reunion, an abstrusely scientific paper would probably be unwelcome to the majority of my hearers. Indeed, I would ask you not to expect a learned discourse from me, for I have had no scientific training which would fit me to deliver one, and there are many present who are, I am sure, better qualified to give an address than to learn anything from me.

I have taken up only one branch of Natural History, viz.: Ornithology, and that entirely in the position of an amateur. The principal reason why I have chosen that especial branch is, that birds seem to attract one's notice more than any other members of the animal kingdom, frequenting, as they do, all the haunts of man. To this science I will ask your attention for a short time; but before enlarging upon it I should like to make a few remarks upon the work done by the Union.

In looking through the list of those Societies forming the Midland Union, and considering the large number of members composing the same, amongst whom will be found many well known as votaries of Natural Science, I am astonished that such a considerable amount of individual labour should be undertaken—which I know to be the case—and that yet the result in the aggregate should be so small.

I think it would be an advantage if at the annual meeting of the Union a special line of study or research could be decided on, so that the accumulated knowledge might be published: a course which would greatly benefit future students. No doubt the chief drawback to a plan of this kind is the jealousy which frequently exists between students of the same subject, and prevents them from working harmoniously together; but this rivalry, if properly exercised, would cause healthy emulation and consequently greater efficiency.

I also wish to call attention to what may be aptly termed economic natural history—I mean the study of such creatures as are injurious to agriculture—with a view to work out their life history, and if possible to point out the best method of preventing their depredations; to distinguish the non-injurious from the injurious kinds, and so to prevent the sacrifice of many innocent victims to popular ignorance or prejudice. A good work of this description is being done by Miss Ormerod on behalf of the Royal Agricultural Society, and I feel sure that many of our county Natural History Societies might follow in her footsteps, both to the advantage of the farmer and to the credit of the society.

The compilation of local lists of the fauna and flora ought to be undertaken by the different societies in their respective districts and published under their auspices. Such lists would form valuable works of reference, and be of incalculable use in future years. Should such work be decided upon no delay ought to take place, as in all probability many of our animals and plants which are still to be found in localities suitable to their respective habits will in a short time become extinct. This is especially true of many of our rarer ferns, which in some districts could be found growing plentifully a few years back, but are now only conspicuous by their absence, which is principally due to the depredation of tourists and exchange clubs. I remember a spot in Hants where *Osmunda regalis* grew so plentifully that the labourers used to cut the fronds for litter; but owing to the demand for specimens the place is now cleared.

I think the amalgamated societies might well raise their protest against such proceedings, and I feel confident that unanimous action on their part would have a satisfactory result.

The principal utility of Natural History Societies, in my opinion, is the finding of employment for the leisure hours of those who are engaged in commercial or other pursuits. In this way the Birmingham Natural History and Microscopical Society has been of great service to me. The recreation to which membership of such a society leads is not only deeply interesting and instructive, but practically affords the greatest amount of rest, inasmuch as different muscles are called into play, while the mind is differently occupied. This change of function produces a great feeling of rest, far greater than that which results from sitting in an armchair, doing nothing, which to me is a state of semi-torture; and it is from this point of view that I have taken up Ornithology as my hobby.

I have confined myself chiefly to the study of British birds, because I think a man ought to be thoroughly conversant with the Natural History of his own country before undertaking that of foreign lands, as a resident has a much better opportunity of studying the life history of any species than he possibly can have when travelling through a strange country.

The Bibliography of Ornithology is most voluminous, but the majority of works are simply compilations from previous authors, and in many instances multiply their errors. I trace the cause of this to the fact that it is impossible for one man to personally investigate the life of all the species of which he gives an account; therefore I strongly advocate the publication of monographs instead of works comprising all orders of birds. The beautiful woodcuts of Bewick gave a great impetus to the study of Ornithology, and the reason why his drawings caused such admiration was that in most cases the drawings were made from life instead of from stuffed specimens, which had been the case in most of the previous works. Since the days of Bewick the art of lithography has been brought to a great state of perfection, and now that we have works illustrated like Gould's, or Sharpe and Dresser's, little is left to be desired. The only improvement I could suggest would be the illustration of the intermediate stages and young birds, instead of the finest adult specimens that can be conceived, which are well known, whereas many birds of the year, or those undergoing partial change of plumage, are little known or appreciated; indeed I have known instances where such birds have been thrown away as not worth preserving, because not adult, though in my opinion such specimens are actually more interesting.

Yarrell's "British Birds,"—of which a fourth edition is now being published—with McGillivray's accurate and observant work, will be found sufficient to give a student a very fair knowledge of our native avi-fauna.

As there are two ways in which Ornithology can be studied I may consider it under two distinct headings, Indoors and Out-of-doors. No doubt a man sitting comfortably in his laboratory can, by the examination of dried skins, specimens in spirits, or the anatomical structure and the formation of the digestive organs of birds, obtain a large amount of knowledge, and with some degree of certainty assign each individual species to its proper family and genus, whatever system of classification he may be following, until he imagines that he has discovered the natural affinity, and forthwith publishes a new system, making confusion more confused, forgetting that there is a marked difference between affinity and analogy, the one being a natural, the other only an artificial arrangement and liable to error, as in Nature all things are perfect in my opinion. This method also leads to multiplication of synonymous names and cannot be too deeply deplored.

I have occupied many hours in studying the Morphology and Physiology of Birds and know of few more beautiful things than the skeleton of a bird, combining as it does strength and lightness with perfect adaptability for the purpose it was designed.

The digestive organs have provided me with a large amount of interesting study, varying as they do in a considerable manner according to the food upon which the bird subsists. The examination of these organs will also show the exact substances which the bird was feeding upon. Only this last week I received from Norfolk two specimens of *Circus cineraceus* whose maws were full of the egg shells of various birds, and from the one, an egg of *Emberiza schœniclus* was taken out unbroken, proving clearly that this species swallows eggs whole. I make a point of preserving the contents of the stomachs in spirits when this is possible, and I find that even in closely allied species their food will often differ slightly.

This style of studying Ornithology may satisfy some people, but I felt that a great deal more knowledge and pleasure was to be obtained by investigating the life history and habits of our native birds as they are displayed in their natural habitats and in a living state. To do this necessitates some exertion and a considerable amount of time, because many of the breeding haunts of our most interesting species are situated in wild spots difficult of approach, but which when visited amply repay the enthusiast. Anyone exploring the Bass Rock would learn more of the natural history of *Sula bassana* in one hour than he would acquire from all the books he might read in a lifetime.

In order to become thoroughly conversant with the natural history of a bird you ought to know its habits, the manner in which it forms its nest, the situation in which it builds, and the localities which it frequents. These points are far more interesting to me than any classification, which I look upon as merely an assistance to memory.

One of the most interesting spots that I know for an ornithological visit is the Farne Islands, off the coast of Northumberland; you will find the various islands composing that group tenanted by their respective species in well-regulated colonies, and the manner in which they are governed might give some useful hints to our political economists. The following species will be found breeding upon these islands, which I have had the pleasure of visiting more than once :—Upon the wide opens Eider Ducks breed in considerable numbers ; with care you can approach within a few feet of the old ducks upon their nests, which they do not leave providing you keep still and make no sudden movements. In a small patch of nettles I should think there were quite ten or more nests. The males of this species undergo a considerable change of plumage before attaining the lovely dress of the adult. That rare bird, the King Eider, *Somateria spectabilis*, has been obtained on these islands twice, once in 1873, and again in this present year. This last bird is in my collection. I saw an example of this species two years ago, whether the same bird as the one I now have it is impossible to say.

The Arctic and Common Terns also breed plentifully upon the same island, the first named choosing the bare shingle just above high water mark, the latter preferring the top of the cliff amongst the short grass and sea campion. On the Knoxes will be found a colony of Sandwich Terns, which lay their eggs upon the bare sand, and you have to walk carefully not to crush the eggs, so closely are they placed together. I thought I never had seen a more beautiful sight when I saw these birds sitting on their eggs early one morning, but as soon as they were aware of my presence they rose in a flock, uttering their shrill cry.

The lovely Roseate Tern also occurs in small numbers, but has no separate breeding station as far as I know.

Puffins and Lesser Black-Backed Gulls, Oyster Catchers, and Ring Dotterels also breed on many of the islands. The Pinnacles, three detached rocks which stand a little way from the island of that name, are a charming sight when the summits are covered with Guillemots, amongst which a few Ringeyes are occasionally discernible, whilst the jutting points of the rock lower down are appropriated by the Kittiwake Gulls for their nests.

Perhaps the most striking spectacle is the Cormorant colony on the Megstone Rock, where the nests are placed on the summit in close proximity to each other, formed of coarse seaweed, some being two feet in height. I have a lively recollection of this breeding station ; upon my first visit, after climbing to the top, my foot slipped and I fell down into the odoriferous refuse surrounding these nests. It was some time before I could think of or imagine anything else but Cormorants.

I was so struck with the beauty of bird life of these islands that I induced Mr. Green, of Berwick, to photograph the various colonies, with the birds on their nests, which he has done most successfully, and copies of the series no doubt he would supply upon application. I certainly claim the credit of originating the idea of photographing the birds in their breeding haunts at the Farnes. Since then Mr. Green has visited the Bass Rock, and has taken a splendid series of pictures of the Gannet.

The Broads of Norfolk are also well worth a visit. There you will find that fast-disappearing little bird *Panurus biarmicus*, the Bearded Tit; the large reed beds in that county forming its last strongholds. In May last year I had the opportunity of seeing this species breeding upon one Broad. It is rather particular in choosing the spot exactly suitable to its requirements, and to a casual observer many of the Broads seem equally suitable; but as this species breeds early in the year, before the reed has grown to any height, they choose the outlying skirts of the reed beds where last year's growth has not been cut, and place their nest close to the ground, amongst but not attached to the reed stems. The marshmen rob the nests time after time; the Tits at once nest again, and instances have been known where the birds have died upon the nest from sheer exhaustion—in fact, have laid themselves to death; even when the birds are allowed to rear a clutch, instead of eight or nine fine young birds hatched early in spring, only three or five are reared, and that so late that the young ones are hardly able to care for themselves before the cold weather sets in. During this same visit I also saw a flock of Ruffs (*Tringa pugnax*), which were associated with some Redshanks upon one of the marshes. I only saw one with his ruff fully developed, which was of rich black colour. Wild Ducks, Redshanks, and Lapwings breed plentifully in most of the fens; also a few nests of the Water Rail can be found in almost inaccessible places amongst the thick sedge.

The rarest nest I found was that of the Garganey Teal (*Querquedula circia*). The old bird flew from the nest almost under the feet of one of my companions, and the temptation being too strong, I pulled the trigger, and the Teal fell wounded. My friend, in his excitement to secure the specimen, went nearly up to his middle in a blind dyke. On Ormsby Broad the Great Crested Grebes (*Podiceps cristatus*) are very abundant. I counted over twenty in sight at one time.

The Scotch moors are well worthy of a visit, and you will find quite a distinctive class of birds in these wild and rugged districts. Some time ago, through the courtesy of the owner of a large shooting tract in Perthshire, I had the opportunity of seeing that splendid bird the Capercailzie (*Tetrao urogallus*), breeding on the summit of the pine-clad mountains. Accompanied by the keepers as guides, I arrived nearly at the top of the mountain, and before long had the pleasure of seeing a nest of this species, which was placed at the foot of a large pine, with a few dried leaves and sticks, simply an apology for a nest, and containing eight eggs. After a further search, I saw a fine male fly from a tree. He went with his head stretched out and tail slightly raised. Soon after a female rose, but I did not get a good view, and did not succeed in discovering her nest.

On the moors, of course, Red Grouse (*Lagopus scoticus*) are predominant, but Common Sandpipers (*Tringoïdes hypoleucus*) will be found breeding on the loch sides, also Curlews and Golden Plover. I took a nest of young, in down, of this last species, and more beautiful little creatures in their black and gold livery I never saw. The keeper and myself were watching a pair of old birds, when I heard "peep," "peep," close to me. Of course I at once instituted a search, and soon found one of the little fellows, and in a short time secured two more. They had run from the nest, and then crouched under a piece of heather or against a lichen-covered stone, trusting that their colour, assimilating with the surroundings, would prove a protection, but their voices and bright eyes betrayed their whereabouts.

There is a very interesting place a few miles from Towyn, called Craig-y-diren or Bird Rock, where some Cormorants for years past have taken up their abode during the breeding season, leaving again in autumn, and when we come to consider that this rock must be about six miles in a straight line from the sea, some idea can be formed as to the labour entailed upon the parent birds to feed a numerous family of young cormorants when their voracious appetites are considered.

In the Cader Idris range, Ravens, Buzzards, and Peregrine Falcons still continue to hold their own against the persecutions of gamekeepers and shepherds.

A visit to any of the places I have just sketched would teach more to a student than years of book-work, because in the first place Nature herself is his teacher, and secondly what he sees is so impressed upon his memory through being associated with many pleasant episodes that he never forgets such knowledge in after years.

One of the specialities of my collection (and every student must necessarily become a collector in his special branch of study, as he requires examples for examination and reference) is the manner in which my specimens are mounted. If a purely scientific arrangement is wished for, a collection should be formed entirely of skins, as being more convenient for examination and requiring less space to store. The stuffed abortions in the majority of our museums cannot give a student the slightest idea of what the bird is in life; rows upon rows of these mummies are placed upon turned stands, all of one pattern; and whether the bird in life would frequent rocks, trees, sea coast, or marshes, it matters not; they are all placed in like circumstances in the glass cases.

In my collection I have endeavoured to reproduce as far as possible the natural habitat of each species, employing surroundings to denote the locality which the species would frequent. Moreover I have shewn the life-history from the young to the adult where possible, and thanks to the improvement of late years in taxidermal art, birds can be made to look perfectly natural, lacking only vitality, which it is impossible to give.

Many collectors I know consider that the bird ought to be the most conspicuous object in the case without any surroundings, as in their opinion they detract from the specimen itself, but I hold that a collection of skins, which I mentioned before, is preferable to specimens mounted in this style. Of course I am well aware that the surroundings can be overdone; the bird itself *should* be of the first importance, but if judicious treatment of the accessories be shown, they rather add to than detract from the appearance of the bird. I shall exhibit in the Town Hall this evening some of cases representing the class of work and system I am endeavouring to carry out.

Many of the auxiliaries in the mounting of the specimens, such as sand, shingle, grasses, &c., also rocks and stones from which the models have been taken, were procured from the same spots as the birds themselves.

I am happy to say that a portion of our national collection, under the care of Mr. R. B. Sharpe, F.Z.S., is being mounted in a somewhat similar manner. Probably many here present have had the pleasure of viewing these new cases in the galleries of South Kensington.

It may be thought by some that our immediate district is rather a poor locality in which to study Ornithology, but if I had time to read over some of my notes, I think the number of species of birds to be found in the neighbourhood of Birmingham would astonish my hearers; but this only goes to prove what I have long contended, that it is not objects and specimens in any locality that are deficient, but Natural History students to discover them.

Natural History, I venture to say in conclusion, is one of the most rational hobbies a man can take up; it brings him in direct contact and communication with Nature; it improves his health and elevates his mind, and, whatever branch he may undertake to study, he will find that honest work never fails of its reward.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

Part I.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 152.)

Bed "K."

This bed is a sandy clay or shale, highly micaceous, varying in colour from grey to light reddish brown, according to the amount of weathering it has undergone. At *Chalcomb* the joints and surfaces are red, and there is a thin line of small concretionary ferruginous nodules. The light-coloured specimens do not effervesce with acids, and the grey ones only slightly. The material of the bed seems very pervious to water, and when it is wet it readily crumbles down. In consequence of these properties most of the fossils are only casts, and they are preserved with difficulty unless the material is dry when they are extracted, but they are rather abundant. The thickness of this bed appears to be about 6ft. At *Chalcomb* it measures 5ft. 7in., *Staverton*, 5ft. 9in. The fossils in this bed so nearly agree with those in the two beds above it that I have not thought it necessary to give separate lists.

Bed "J."

This bed differs very little in appearance and fossils from the two softer beds between which it occurs. It is yellowish brown in colour, micaceous, and ferruginous where I have found it, and when specimens of it are placed side by side with others from the beds immediately above and below it they are scarcely distinguishable without an appeal to the hardness. The hardness appears to be due to carbonate of lime, at least there is no other evident cause for it. Although this bed is so nearly like the two between which it is placed, and is probably not persistent over any large area, I have found it useful in giving an idea of the development of the Middle Lias beds, where the softer beds are covered up—on the grassy slopes of a railway bank, for instance. The thickness of this bed is about 2ft. at Staverton, and nearly 3ft. at Watford.

BED "I."

The number of sections in which this bed can be seen is very limited, but it appears to be almost exactly like the bed "K." I have only been able to actually measure it at one place, Staverton, and there it has a thickness of 4ft.

LIST OF FOSSILS FROM BEDS "K," "J," "I."

Ammonites margaritatus...	Chalcomb, Milton, Newnham.
Belemnites	Milton.
Ostrea submargaritacea	Chalcomb.
Ostrea sportella	Milton.
Ostrea cymbium	Milton.
Pecten æquivalvis	Chalcomb, Milton.
Pecten liasinus (small) ...	Chalcomb, Staverton, Watford, Newnham.
Limea acuticosta...	Chalcomb, Staverton, Watford, Newnham.
Plicatula spinosa.....	Milton (abundant).
Avicula inæquivalvis........	Chalcomb, Milton (abundant).
Modiola subcancellata (?) ..	Chalcomb.
Modiola numismalis (?)	Chalcomb.
Protocardium truncatum ..	Chalcomb, Milton, Staverton, Watford.
Cardinia antiqua	Milton (abundant).
Astarte striato-sulcata......	Chalcomb.
Pholadomya ambigua	Chalcomb, Newnham.
Arca liasina	Chalcomb, Watford.
Arcomya hispida......... ..	Chalcomb.
Unicardium globosum......	Chalcomb.
Pleuromya costata....... ..	Milton, Chalcomb.
Pleuromya granata (?).....	Milton.
Encrinite stems..............	Milton, Staverton.
Fucoid markings............	Staverton, Watford.

BED "H."

The general character of this bed is that of a soft red sandstone abounding in fossils. It appears to be micaceous and calcareous in some places and not in others; also it varies considerably in the amount of iron it contains, and in the relative abundance of certain fossils. The bed may be best examined at Byfield, Staverton, and near Daventry. At *Byfield* it is 3ft. 3in. in thickness, and is a homogeneous red sandstone containing two or three species of *Pholadomya* in abundance, together with a fair number of specimens of *Protocardium truncatum* and *Pleuromya costata*. At *Staverton* it is almost an ironstone, and somewhat cellular in structure; Pholadomyas are not so common, but *Protocardium truncatum* more so. I believe the latter fossil is more common in this bed than in any other bed of the Middle Lias of Northamptonshire. It is found in masses—somewhat like *Rhynchonella tetrahedra* in the Rock bed—at certain places. Thickness at Staverton, 2ft. 9in.

FOSSILS.

Ammonites margaritatus... Byfield.
Ostrea cymbium............ Staverton.
Pecten liasinus.............. Byfield.
Limea acuticosta........... Byfield.
Avicula inæquivalvis ... ... Byfield, Staverton.
Arca elongata............... Staverton.
Modiola numismalis........ Byfield.
Protocardium truncatum... Byfield, Staverton, &c.
Cardita multicostata....... Staverton, Byfield.
Pholadomya ambigua...... Byfield, Staverton.
Pholadomya Simpsoni ..... Byfield.
Pholadomya obtusalis...... Byfield.
Pleuromya costata.......... Byfield, Staverton.
Arcomya concinna (?)...... Staverton.
Ceromya petricosa.......... Byfield.
Goniomya heteropleura.... Byfield.
Isocardia liassica (?) .... Byfield.
Pentacrinite stems .... Staverton.
Wood, and cavities left by stems of plants......... Byfield, Staverton.
Calc spar—a little.......... Byfield.

BED "G."

This bed is a micaceous sandy clay or marl, of a dark blue colour when first exposed, but getting much lighter coloured on exposure; it appears to contain fewer fossils than any of the beds below it. There was a very good exposure of it near to *Byfield* during the making of the East and West Junction Railway, where it was found to measure 6ft. 2in. It may be seen at *Staverton*, but it is so situated that I have not been able to measure it. It is probably between 6ft. and 7ft. in thickness near *Northampton*. I have found no fossils in this bed that are not also in the beds both above and below it.

BED "F."

A soft, sandy, ferruginous limestone, generally shaly, and very fossiliferous, some parts being made up of comminuted shells. The fossils in this bed are better preserved than in any of the beds at present described, except "L." *Ammonites margaritatus* and *Pleuromya costata* are particularly abundant at Byfield. The best places for examining it are near to *Byfield* and *Watford* respectively. At each of these places it has a thickness of about 3ft.

FOSSILS.

Ammonites margaritatus...	Byfield.
Ammonites margaritatus, var. subnodosus.........	Byfield.
Belemnites....................	Byfield, Watford.
Chemnitzia (*sp.* ?)	Watford.
Turbo aciculus	Byfield.
Ostrea cymbium.............	Byfield, Watford, &c.
Ostrea sportella	Byfield.
Pecten æquivalvis...........	Byfield, Watford.
Pecten liasinus..............	Byfield, Watford.
Limea acuticosta............	Byfield, Watford.
Plicatula spinosa...........	Byfield, Watford.
Avicula inæquivalvis	Byfield.
Pinna (*sp.* ?)................	Byfield.
Inoceramus substriatus	Byfield.
Modiola numismalis........	Byfield.
Protocardium truncatum...	Byfield, Watford.
Cucullæa transversa........	Byfield.
Unicardium globosum......	Byfield.
Astarte striato-sulcata......	Watford.
Cardita multicostata........	Byfield, Watford.
Pholadomya ambigua......	Byfield, Watford.
Pleuromya costata..........	Byfield, Watford.
Pleuromya (*sp.* ?)	Byfield.
Arcomya hispida............	Byfield.
Cardinia lævis............ ..	Watford.
Serpula	Byfield, Watford.

(To be continued.)

A SUCCESSFUL POND HUNT.

BY THOMAS BOLTON, F.R.M.S.

On Saturday afternoon, May 2nd, the President of the Birmingham Natural History and Microscopical Society took me to a small farm at King's Norton "ponderneering," as a friend of mine calls it; nearly every field on the farm contained a small pool or marl-pit, and I think it may interest your readers to give an account of my collections.

In the first pool I saw at a glance that there was a promise (afterwards confirmed) of Spirogyra in conjugation, which I wanted for a botanical class. The water was also full of Entomostraca, watermites, and beetles.

The second pool we visited was thick with *Volvox globator*, amongst which were plenty of *Diaptomus castor* and the larvæ of *Corethra plumicornis*, the glass-larva, which latter wonderfully transparent larva, with its curious kidney-shaped air-vessels in its chest and tail by which it floats horizontally, was abundantly found in nearly all the pools.

From the last and one of the largest pools I was glad to pull out some transparent Nitella, which proved to be *Nitella flexilis*, not, I think, previously recorded for Worcestershire. I could see that it was nicely covered with various living animals, and the first dip from this pool showed that the water was thick with countless numbers of the Infusorian, *Peridinium tabulatum*. I then threw in my drag and pulled out some of the Potamogeton, which I found to be bristling with the universal favourite of microscopists, the wonderful building Rotifer, *Melicerta ringens*.

I was well pleased with my visit, and could see with my pocket lens that there were many free Rotifers and Infusoria, too small to identify without the more powerful table microscope; so when I called at my studio on my return to deposit my collections I took a hasty glance at the Nitella, and soon found amongst a host of interesting organisms a beautiful *Floscularia longicaudata*, which was discovered near Aberdeen for the first time by Mr. Hood in 1871 (see "Royal Microscopical Society's Journal," 1873), and which has not previously been recorded in England. I could with pleasure have studied this little bit of Nitella, and the inhabitants that clothed it, for hours, but it was so late that I was obliged to defer further examination of it. On Monday I was pleased to find an Infusorian I had not seen before, *Phalansterium digitatum*, which Mr. Saville Kent reports in his Manual of the Infusoria as not having been discovered in Great Britain; his description and figure were copied from the German publication of Stein. The small zoophyte trough in which I have discovered this has remained unchanged in the Society's library ever since, forming a diminutive aquarium, and a good part of the organisms enumerated below I have seen in this small portion of my gathering.

As we were walking round, the gentleman holding the farm told us the cattle in the neighbourhood suffered from the fluke, so I at once looked for the water snails, which usually form the intermediate host, giving out the *Cercaria* which the sheep or cattle devour with the grass. I did not find a single specimen then, but have since found in a pool on a neighbouring farm an abundance of *Limnæa stagnalis*, with quantities of that same *Cercaria* which I have shown before as parasites of this snail, and of which I have given a sketch in my Portfolio, No. 6.

At the time I issued that sketch I was under the impression that this was the *Cercaria* of the sheep fluke, *Fasciola hepatica*, but Mr. A. P. Thomas, in his exhaustive account of the life-history of this parasite in the "Quarterly Journal of Microscopical Science" (January, 1883), states that that species cannot exist in *Limnæa stagnalis*, and that its usual host is a much smaller species, *Limnæa truncatula*.

On comparison of my sketch with Mr. Thomas's figures they will be found to differ, I think, sufficiently to suggest that this is another species, and it would be well if some one would work out its life history, as it is quite possible that the *Cercaria* from *Limnæa stagnalis* may be the larval form of the fluke of the cattle.

LIST OF ORGANISMS COLLECTED.

Nitella flexilis (in fructification).
Spirogyra (in conjugation).
Bulbochæte.
Volvox globator.

Uroglena Volvox.
Phalansterium digitatum.
Vorticellæ (various).
Carchesium polypinum.
Epistylis grandis.
Stentor cœruleus.
Cothurnia imberbis.
Vaginicola tincta.
Thuricola valvata.
Platycola decumbens.
Peridinium tabulatum.
Amphileptus meleagris.
Chætogaster diaphanus.
Nais —— ?

ROTIFERA.

Chætonotus larus.
Floscularia cornuta.
F. longicaudata.
Stephanoceros Eichhornii.
Melicerta ringens.
Cephalosiphon limnias.
Notommata parasita.
Rhinops vitrea.
Triarthra longiseta.
Mastigocerca carinata.
Metopidia acuminata.
Euchlanis triquetra.
Salpina mucronata.
Rotifer macrurus.
Philodina megalotrocha.

Tardigrada.
Plumatella repens (emerging from the statoblast).

MORCHELLA SEMILIBERA, DC.—This somewhat rare fungus was gathered at Eaton Constantine, near Shrewsbury, by Mr. W. E. Beckwith, in the beginning of May last. This is the first record of its occurrence in Shropshire.—W. PHILLIPS, Shrewsbury.

PENNATULIDA.

MICROSCOPIC SECTIONS AND THE MODE OF AUTOMATIC SECTION-CUTTING AND MOUNTING.*

BY W. P. MARSHALL, M.I.C.E.

The preparation of the objects for section-cutting by hardening, staining, and imbedding is the same as usual; the special points to be described are the method of cutting the sections and of mounting them.

The sections are cut by an automatic machine, which performs the operation with great rapidity, as many as 100 sections being cut per minute, and with such absolute uniformity and regularity that the successive sections as they are cut adhere together by their edges, following close after one another, so as actually to form a continuous ribbon of one or two feet in length. This ribbon is then divided into about 2½ inch lengths, suitable for mounting on the ordinary three inch glass slides, three separate rows of the sections being often got upon a single slide. The special practical advantage arises from this, that the very large number of these sections, each only $\frac{1}{1000}$th or $\frac{1}{2000}$th inch thickness, that are required to make up a complete object, can be all conveniently contained upon only a few slides; also all these sections are retained strictly in their correct consecutive order for proper examination of the structure of the object. In the case of the Funiculina slides now exhibited, there are as many as fifty separate sections on a single slide, and the total number of 270 sections that is required to complete the set of sections of a single polype from one extremity to the other is contained upon only six slides.

The process of preparing an object for section-cutting is first to harden or toughen it sufficiently to stand the subsequent imbedding without distortion or displacement, and then to imbed the object in paraffin for giving firm support to it during the operation of cutting the sections.

The object is taken from the ninety per cent. alcohol in which it had been previously kept, and in which it can be safely kept any length of time till wanted for preparing, and is then hardened by soaking in a weak solution of picric acid or chromic acid, the strength of acid and time of soaking being varied according to the delicacy of the object. The object is then transferred to absolute alcohol for getting rid of all traces of water, and at this stage it is in most cases stained by hæmatoxylin or other reagents for the purpose of

* Transactions of the Birmingham Natural History and Microscopical Society. Read at a Meeting of the Society. April 21st., 1885.

distinguishing clearly the transparent tissues in the sections. In the case of the Funiculina and Pennatula polypes, which both contain a number of hard calcareous spicules, these have also to be decalcified before the sections can be cut, by soaking the object in very dilute hydrochloric or nitric acid for a week or fortnight; a very gradual process being desirable in order to avoid any evolution of gas in the tissue that might cause some rupture or displacement.

The object is then imbedded in paraffin in a small paper trough or mould, not larger than enough to insure a margin of paraffin of not less than $\frac{1}{8}^{th}$ inch on all sides beyond the object. Some melted paraffin is poured into the mould, the object is laid centrally upon this, and the mould filled up with melted paraffin; the whole is then exposed to a uniform temperature of 130° or 140° Fahr. in a soaking chamber of a water-oven for a whole day, for the purpose of getting the paraffin thoroughly to permeate the tissues of the object. This is a point of special importance, as it is requisite to have the whole like a thoroughly solid block of paraffin in order to obtain sound unbroken sections. Also it is necessary to employ paraffin of the exact degree of hardness and stiffness according to the temperature of the room in which the section-cutting is to be done, that will give sections tough enough not to break, and soft enough to stick together at their edges, without being so soft as to stick to the razor, which is used quite dry and clean. This point is obtained by selecting the paraffin from several different qualities, which can be obtained having melting points at different temperatures, and varying the selection according to the seasons of the year and circumstances of the room. This plan is found, with a little practice, to yield the most satisfactory results, the material being homogeneous, and working better in the cutting than any mixture of oil or other material with the paraffin to modify its hardness.

A holder is then made for the object whilst being cut, by a small brass tube as a mould, closed at the bottom with a cork, and filled with melted paraffin, into which, when set, the little paraffin block containing the object is fixed by making a central cavity with a hot wire, and bedding it in solid by melting the paraffin around it with the hot wire, leaving the little block projecting partly at the top. The projection is pared away carefully until the imbedded object is seen to be near the surface, and the sides are pared away into a square form with parallel sides, leaving only such a margin at the sides beyond the object as is found by experience to supply sufficient strength to the sections to hold together when cut, without incumbering them with any superfluous quantity of paraffin. It is important for the sides to be cut parallel in order to get the successive sections to stick together properly for forming a continuous ribbon.

The razor blade by which the sections are cut is in the machine made a fixture, and the object to be cut is moved to and fro against the blade; instead of the object being stationary and the blade moved, as in section-cutting by hand. The use of this is to obtain a continuous unbroken series of sections forming a continuous ribbon, which passes across the blade, and is received upon a travelling band that moves forward at the same rate as the sections are cut, standing still during the return motion of the sliding block that carries the object back in preparation for the next cut. The object holder is supported by a screw of fine pitch which has a ratchet wheel fixed upon its head, and in each return stroke of the sliding block this ratchet wheel meets a catch which turns it round one or more teeth, according to the desired adjustment, and thus advances the screw to raise the object the thickness of the next cut. This can be adjusted so that the thickness of each section is uniformly $\frac{1}{1000}$th inch or $\frac{1}{2000}$th inch, or otherwise as may be desired. The driving wheel is either turned by hand, or it can be driven by power by means of a band round the circumference of the wheel. It is readily driven by hand at the rate of 100 sections cut per minute, and can be driven by power at a higher rate without difficulty, and the quick motion is advantageous to the perfect condition of the sections.

For the mounting of the sections, the glass slide is first covered with a thin film of collodion, mixed with an equal quantity of oil of cloves, which is dropped on the slide and levelled by a needle held flat across the slide, and stroked down its whole length. The ribbon of sections is cut into lengths to suit the slide, and the pieces dropped on to the slide, guided by a needle, in two or three rows, according to the width of the sections, and they adhere firmly upon the collodion film. The slide is then exposed to a uniform heat of 130° to 140° Fahr. for half a day to soften the paraffin and make it readily soluble in turpentine, and the whole slide is then dipped endways into a bottle of turpentine, by which the paraffin is all dissolved off at once, if properly softened. The slide is then mounted direct in balsam, by dropping on some balsam diluted with turpentine, and applying either a single cover glass of the whole length, or two or more square cover glasses to make up the required length. The sections remain quite fixed on the slide in the positions they were originally placed upon the collodion film, and there is no danger of any displacement or injury in the subsequent processes of the mounting.

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(Continued from page 167.)

The Bunter Conglomerate.—This great accumulation of more or less rounded blocks of rock can be traced across the North Midlands from Worcester, by Bridgnorth, Stourbridge, Cannock Chase, Sutton Park, and Lichfield, to near Ashbourn and Derby. In a north-easterly direction it becomes a pebbly sandstone at Nottingham and in Sherwood Forest; but further north, near Selby, the pebbles disappear altogether, and in the borings through the Trias at Scarle, and near Middlesbro', none were met with. The same change takes place in the west, for the pebbles in the Bunter round Liverpool are small and few, while in the Carlisle district the lower Trias is not represented at all. In any case its only possible representative—the Kirklinton sandstone *—is quite devoid of pebbles.

The base of the Bunter Conglomerate is a breccia, sixty feet thick near Kidderminster, and well exposed at Bridgnorth and Kinver Edge. It consists of more or less angular fragments of grits, quartz, quartzite, sandstone, slate, and limestone. Above this we find from 100 to 300 feet of well-rounded pebbles, principally quartzites, although specimens of vein-quartz, chert, hard sandstones, mountain limestone, and traps and ashes, are present. Owing to the earth-movements in which the bed, as a whole, has taken part, the pebbles have been crushed against one another, so that they bear indentations which appear as white spots upon their surfaces. By the action of surface agents—principally ice during the last glacial period—immense numbers of the Bunter pebbles have been carried southward from the outcrop, and can be traced as far as the brow of the Thames valley.

The Trias has generally been regarded as an uninteresting set of rocks, owing to the almost total absence of fossils in its red marls and sandstones. This paucity of traces of life is usually assigned to the mode of its formation—deposited in a salt lake or lakes comparable with the Dead Sea or Lake Utah at the present day. But the pebbles of the Bunter contain numerous fossils, and if we are ever to know much of the source and mode of formation of this very remarkable and interesting conglomerate it must be by a close study of

* See T. V. Holmes, Q.J.G.S., Vol. XXXVII., p. 286.

these fossils, aided by a careful examination of the rock fragments which contain and accompany them. Such a study has only recently been possible, so that but scanty results have as yet been obtained.

Fossils in Bunter Pebbles.—The lowest horizon to which any of the fossils as yet discovered in the Bunter belong is (according to Mr. Thos. Davidson, to whom I am much indebted for his identification of the species) the equivalent of the Arenig Beds, which form the quartzite of the Stiper Stones west of the Longmynd, and are present in Brittany as a very similar rock—the *Grès Armoricain.* This Lower Silurian formation has yielded numerous pebbles of quartzite and indurated sandstone to the Midland Bunter, which can be identified by the presence of the fine brachiopod *Lingula Lesueuri,** and such lamellibranchs as *Modiolopsis**, *Palæarca* (which is found *in situ* in the Arenigs near Norbury), and *Lyrodesma.*

Next in order of time we find representatives of the Caradoc and Bala Beds, including *Orthis Budleighensis,** which occurs more frequently than any other species; *O. Valpyana*, *O. elegantula*, *O. unguis*, *O. biforata*, *O. calligramma*,* and *Leptæna sericea.* Shells of the genera *Pterinea*,* *Ctenodonta*, and *Cleidophorus* may also be referred to this period, and remains of a crinoid—probably *Glyptocrinus basalis.**

From the Upper Llandovery Beds we get sandstone pebbles (identical in character with the rock which fringes the eastern side of the Lickey) containing internal casts of *Stricklandinia lirata,** and the coral *Petraia bina.**

Although no Devonian strata crop out in the Midlands, yet we find quartzose sandstones of this age—proved to be Devonian by the fossils they contain—in the Bunter.

The commonest Devonian fossil is *Spirifera Verneuilii*, with which we get *Rhynchonella daleidensis*, *R. Valpyana*, *R. elliptica*,* *R. Thebaulti*, *Orthis laticosta*, *O. Monnieri*, *Strophomena Edgelliana*, and *Streptorhynchus crenistria.** Worm-burrows, belonging to *Trachyderma serrata*,* &c., are very common in the quartzite pebbles, but I have never found any other fossil in the same pebble. Fragmentary remains of other fossils, as a *Theca*, the trilobites *Phacops** and *Homalonotus*, and fucoids, are not rare, but they are usually too imperfect for specific determination.

Of the above fossils I have found those marked with an asterisk both in the drift-gravels round Birmingham and in the Bunter Beds of Sutton Park. That the entire suite is to be found in the Bunter I have no doubt, but I have not had a good opportunity of collecting from that deposit, while the quartzite pebbles of the gravels are largely excavated and broken up for road-mending near my house. Several of the species named above have also been collected by Prof. Bonney from the Bunter of Cannock Chase, by the Rev. P. B. Brodie from the Drift at Rowington, by Messrs. Jennings and Shipman from the Bunter of Nottingham, by Mr. A. H. Atkins from the pebble-beds of Kinver Edge, and by Mr. F. T. S. Houghton from the Drift near Moseley. Many years ago Mr. S. G. Perceval collected diligently from the drift at Harborne and at Moseley, suburbs of Birmingham.

Mr. W. Molyneux has obtained from the Bunter of Cannock twenty species of fossils belonging to the May Hill Sandstone, and twenty-two species in pebbles of Mountain Limestone. A more exhaustive examination of the Bunter pebble-beds along their course from west to east is much to be desired, and is a work well worthy of the best energies of those who live near places where this formation is well exposed. The conditions of search will be most favourable in pits where the pebbles are broken up for road-metal, and the services of the workmen should be enlisted in the search. Not only should the fossiliferous pebbles be collected, but as complete a set as possible of the rock-varieties represented should be secured.

The Keuper Pebble Bed.—In the Midlands, there is an unconformity between the Bunter and the Keuper, and the latter formation is ushered in—locally—by a breccia which resembles that found at the base of the Bunter. It contains numerous angular quartzite pebbles, and its extreme thickness is forty feet. In the Alton and Peckforton Hills this Keuper breccia is repeated by strike-faults, and so forms two or three ridges parallel to one another. No thorough examination of the pebbles has yet been made, a task which local geologists might well undertake.

The Pebble Bed of Budleigh Salterton.—In looking elsewhere for an analogy to the Bunter Conglomerate of the Midlands our attention is at once arrested by the remarkable accumulation of quartzite pebbles which form a bed eighty feet thick in the Triassic cliffs at Budleigh Salterton, near Exmouth, in Devonshire. In a beautiful monograph on the fossil brachiopods obtained from this locality, Mr. Davidson has described * twelve species from the Arenigs; eight from the Caradoc; and thirty-three from the Lower Devonian formation; about thirty other species of fossils belonging to these formations have been found at Budleigh, by Messrs. Wyatt-Edgell, W. Linford, W. Vicary, and others.

* Volume of the Palæontographical Society for 1881.

It will be seen that in lithological character and palæontological contents the resemblance to the Midland Bunter is very close. Of the nineteen species of brachiopods found near Birmingham, eight are known from Budleigh Salterton; and the accompanying fossils are also very similar. From general considerations the Devonshire geologists have been led to assign the rocks from which the Budleigh pebbles were derived to a position somewhere in the English Channel, but it seems to me quite possible that they may have come from the north-east; the ancient Midland land barrier—isthmus like—yielding a supply of rock-fragments (though not necessarily contemporaneously), both to the north and to the south.

At a later period—early in Tertiary times—the Oldhaven Beds of Kent and Surrey show a mass of flint pebbles (derived from the chalk) with which, in a sandy matrix, are many contemporaneous marine fossils.

At the present day the famous Chesil Beach of Dorset, the Cahore Beach near Wexford, and the similar beaches which fringe Lake Superior afford instances of vast accumulations of well-rolled pebbles produced by the action of currents and tides, aided by the configuration of the land.

Underground Extension of the Pre-Carboniferous Rocks.—It goes without saying that the isolated outcrops of Laurentian, Cambrian, and Silurian rocks, which we have described as occurring between Charnwood and the Malverns, must be connected underground by a continuation of the strata. Of the presence and position of these pre-carboniferous rocks we have had evidence afforded by several borings. In the first place it seems pretty clear that these three great geological formations were once continuous over the Midland area, and that where the Cambrians are absent, and we come upon Silurian, or where both Cambrian and Silurian strata are wanting, and the borehole enters the Archæans, it is because one or both of the newer formations has been removed by denudation in post-Silurian times. Secondly, there is an absence of rocks of the type of the Old Red Sandstone. Strata belonging to the coeval Devonians have, however, been reached in the borings at Turnford, and in London, and it is probable that these include a band of quartzite, from which the fossiliferous pebbles that occur in the Midland Bunter, with such Devonian species as *Spirifera Verneuilii*, have been derived. Thus the first appearance of the Midland Axis, or land barrier, was probably during Devonian times, and this land had its southern margin somewhere along the Charnwood-Malvern line.

During the Carboniferous era the existence of land in Mid-England is demonstrated by the absence of the mountain limestone and millstone grit. The northern margin of the axis probably consisted of Silurian shales.

In Permian and Triassic times bolder cliffs and hills furnished the breccias and pebble-beds of the Permian and Bunter; while the continued existence of the ridge during the Jurassic epoch is shown by the manner in which the Liassic and Oolitic strata thin as they approach it, and by the pebbles contained in the Lower Greensand, &c. Finally, the old land disappeared beneath the waters of the cretaceous ocean.

Keeping these facts in mind we can apply them to discover the probable nature of the rocks to be found beneath the Mesozoic strata of the Midlands. Borings through these Mesozoic rocks are likely to be undertaken for two objects only:—

(*a*) In search of Water.

(*b*) In search of Coal.

The Bunter sands and pebble-beds form the main source of underground water supply of the Midlands, and the towns of Leicester, Northampton, &c., have hoped to derive from them a supply comparable with that obtained at Birmingham, Stourbridge, &c. But as we go south and south-east we approach the ancient land barrier, and the Lower Trias thins away and disappears; so that the Bunter is all but absent in Leicestershire, and entirely absent in Northamptonshire.

As respects the probable occurrence of seams of coal, a similar change must be taken into account. The present southern boundary of the coal fields of Warwickshire, Leicestershire, and Staffordshire nearly represents the ancient termination of the swamps on which the coal plants grew; and the region between the Hartshill-Malvern line on the north, and the Thames Valley on the south, includes an area in which buried coal fields are not likely to be found.

THE BITTERN IN SUTTON PARK.—It is perhaps scarcely necessary to warn the naturalists of the Midlands against believing in the occurrence of the Bittern in Sutton Park without further evidence than that afforded by Mr. Bath (p. 107). Mr. Bath will now, I think, allow that his statements were founded upon a regrettable mistake. The so-called Black Tern (p. 108) also may have been another bird, and the mistake in the identification of the animal called a Pine Marten (p. 109) is so obvious as to need only to be pointed out.—W. B. GROVE, B.A.

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from 169.)

The walls of the tympanic cavity are bony, lined with mucous membrane, and ciliated. The inner wall contains two orifices leading into the internal ear, and closed by a membrane somewhat similar to the tympanic. The larger of these openings (the *fenestra ovalis*) is oval, the smaller (the *fenestra rotunda*) is round. We may, perhaps, explain the use of these openings by noting that in passing from air to water directly, sonorous vibrations are greatly weakened, but that the interposition of a tense membrane between the two media greatly intensifies the vibrations. Crossing the tympanum is a chain of very small bones—the *Malleus* is attached by its slender end, or handle, to the tympanic membrane,—the *Incus*—a bicuspid tooth-shaped bone, rests by its body on the head of the malleus, whilst the longer of its two fang-like processes is articulated by a round tubercle, by some called the *orbicular bone*, with the *Stapes* which covers with its base the fenestra ovalis. These beautiful little bones have synovial membranes and capsular ligaments at their articulations, as in the case of the other perfect joints of the body, and are covered by mucous membrane reflected from the tympanic walls. Any vibration which, passing up the outer canal, affects the tympanic membrane, is conveyed with great intensity through these bones to the fenestra ovalis, the membrane of which is thus strongly agitated. The movements of the tympanic membrane cause the long processes of the malleus and incus to swing like a pendulum upon the axis furnished by the short processes of these two bones.

Two distinct theories are offered as to the route which the sonorous vibrations follow—1. That they pass through the ossicles merely, causing both molar and molecular vibration; and 2, That the air in the drum is set vibrating by the outer membrane. The considerations guiding our preference are (*a*) the drum is not a perfectly closed chamber, and any vibrations excited in its contained air would be liable to escape by the eustachian tube; (*b*) its internal surface is constantly moist, but moisture tends to deaden vibration; (*c*) the bones form a complete link across the drum, and it is well known that solids conduct vibrations more rapidly and forcibly than fluids; (*d*) they are covered with a moist membrane which, by being a bad conductor of vibrations, tends to prevent the vibrations passing through them being weakened by diffusion, and (*e*) in the internal ear there are *six* separate canals, with five of which the fenestra ovalis communicates, and, being covered by the stapes, air vibrations would be obstructed in their passage to the labyrinth through it, whilst the fenestra rotunda, which is exposed, communicates only with one of the internal canals. Hence the vibrations would seem to be transmitted through the bones, partly by their molecular, but chiefly by their absolute movement. The theory of mixed transmission through the co-operation of air and bones seems untenable, inasmuch as vibrations travel through them with different velocities. Edouard Weber thought the fenestra rotunda, by means of its elastic covering, acts as an adjunct to the fenestra ovalis, facilitating the approximation and removal of the stapes from the labyrinth, by its alternate compensating movements towards and from the tympanic cavity.

The *Labyrinth* (the essential part of the organ of hearing) consists of a small bony chamber, called the vestibule, three semicircular canals (two vertical and one horizontal), and a structure called, from its resemblance to a small shell, the cochlea, all hollowed out of the hardest (petrous) part of the temporal bone.

The *Vestibule* is a small irregular chamber about the size of a grain of barley. Leading from it are the five openings of the three semicircular canals (three in the posterior and lower, and two in the superior horn)—several openings in its inner wall for the entrance of the auditory nerve filaments,—the fenestra ovalis in its outer wall,—the opening leading to the cochlea in its inferior and anterior wall—and in its posterior wall an opening called the *aqueductus vestibuli*, with uncertain contents and office. The vestibule contains two distinct membranous bags—the larger, oval in shape, called the *common utricle*, from which spring the three membranous canals lining the bony semicircular canals; the smaller bag somewhat globular (hence called the *sacculus hemisphericus*).—It communicates with the middle chamber of the cochlea (the Scala Media). The membranous labyrinth contains a watery fluid called endolymph, whilst it is separated from the bony labyrinth by a similar fluid called the perilymph. These fluids contain small particles, composed of carbonate and phosphate of lime, to which their discoverer, Breschet, gave the name of otoconia (ear-dust). Branches of the auditory nerve enter the utricle and semicircular canals and are thus affected by any vibrations which occur in the contained fluids, the effect being intensified by the bombardment of the otoconia, found chiefly in the vestibule, and by the peculiar arrangement found at the orifices of the semicircular canals, which have a diameter of about $\frac{1}{20}$ inch. Where these join the vestibule they dilate into three ampullæ. On the inner walls of these ampullæ are found a number of minute hair-like filaments, which, being connected at their bases with auditory nerve filaments, are very sensitive to impressions of sonorous undulations. The function of the semicircular canals has been thought to be the collection in their fluid contents of the sonorous undulations communicated through the cranial bones, and the magnification of the vibrations excited, in the ampullæ and utriculus, in which they are assisted by the crystalline pulverulent ear stones, which, as above noted, tend to reinforce sonorous vibrations both by their resonance and by their bombardment of the epithelial cells of the vestibule.

The *Cochlea* is situated in front of the vestibule on the inner side of the internal meatus of the ear. It is a very complicated structure, somewhat resembling a snail shell, having two turns and a half in its spiral. We may, perhaps, best represent it by a tube about half an inch long, having a diameter of one-tenth of an inch at its base and one-twentieth of an inch at its termination, divided longitudinally into three unequal compartments, and coiled two and a-half times round a central conical pillar (the *modiolus*). The base of the modiolus is pierced by canals for branches of the auditory nerve (entering through the internal meatus), and blood-vessels. The largest of these canals is called the central canal of the modiolus. The middle and smallest of the chambers of the cochlea is called the Scala Media (or *canalis cochlearis*). It is a continuation of the membranous labyrinth, and completes the division between the other two chambers. It is closed towards the top of the cochlea and opens below by a small neck into the Sacculus of the vestibule. The other two chambers are named from their connections. The Scala Vestibuli opens into the bony vestibule, and is thus open only to the action of the perilymph; the Scala Tympani communicates with the tympanum and the fenestra rotunda. At the top of the cochlea the scalæ tympani and vestibuli communicate by a small aperture called the Helicotrema, left between the top of the modiolus and the Hamulus, or small hooked termination of the Lamina Spiralis which is the partition, partly bony and partly membranous, separating the two larger scalæ.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.
BY HERBERT SPENCER.

EXPOSITION OF CHAPTER XI.—ON "CLASSIFICATION."

[ABSTRACT.]

BY PROF. W. HILLHOUSE, M.A., F.L.S.

Classification has a two-fold purpose; to render identification more easy, and to organise knowledge. When a librarian arranges his books according to their authors' names he renders the identification, *i.e.*, the discovery of any particular one, easy, and he renders it easy likewise to insert in its proper position any work subsequently written. But this arrangement has one systematic weakness; the practical impossibility of finding a work of which you know everything excepting the smallest part—its author's name. Or the books may be arranged according to subject, in which case grouping and sub-grouping to several degrees will, in a large library, have to be resorted to. Further, this involves some knowledge of the contents of the books, and, to be philosophical, a conception, to some degree definite, of not merely the present but the proximate, not to say ultimate, extent of knowledge. This latter method would of necessity come late in the history of books.

Each of these methods is, but in varying degree, a classification by the attributes or properties of the books; in the former case but one attribute, the author's name, is used. Any other single attribute could equally be used, knowledge of the attribute being then alone required for identification; the books can then be placed in definite order or series. In the other case several attributes may be in use, and variously in use, for each volume; here, therefore, true linear arrangement becomes impossible, for there is no reason, other than empyrical, for giving priority to any group of books or to any book in a group; all that you can do is to constitute groups, of which you can indicate the relationship. The growth of such a method must be slow.

Other things being equal, the relations amongst phenomena are recognisable in the order of their conspicuousness and simplicity. *Cæteris paribus*, a child will more readily first recognise the male by a beard. Then all bearded males become "papas." With advancing perceptive powers differentiation comes into play, and with it a tendency to more accurate grouping. In the history of the knowledge-relations of a race, the same principles are involved, and classificatory notions would go through a cycle of phases, at first exceedingly simple, gradually increasing in complexity and accuracy of differentiation ; individual qualities or attributes would be replaced by groups of qualities or attributes ; objects possessing some of one and some of another group would have their attributes analysed, and comparative values would thus be given to each individual quality. The ultimate classification would therefore imply not merely knowledge of many attributes of the object in question, but the relative importance of these in some, at first no doubt empyrical, scale, and the mere position given to an object would give us the largest possible amount of information about it and its attributes.

An illustration of the growth of the classificatory idea is afforded by the common dictionary or encyclopædia. Itself the proof of great advance, in it, nevertheless, but one property, and that artificial in the extreme, viz., the order of the letters, is the key to the whole system, and "Baby," with its appendages, is found next door to "Babylon," "Dog" to "Dogma," "Hosier" to "Hospice" and "Hospital." A step in advance is shown by a recently published Anglo-French Dictionary, where all the words of common root origin are kept together, and apart from all the words of other root origin. The highest stage of verbal classification is shown, perhaps, by such a work as the "Thesaurus of English Words and Phrases" of Dr. Roget, in which the words are systematically arranged according to their actual value and relations, whether abstract, or in space, matter, &c., and quite independently of root origin. But the inapplicability of such classifications to finite beings, in a subject in such general use as language, is shown by the provision of an alphabetical glossary as a key to the whole. Such highly developed forms of classification emanate from, and appeal only to, the specialist.

Natural objects of course come upon a different footing to words ; but here, too, probably the most perfect classification for specialists will be that which, based as far as may be on, to borrow our above phrase, *common root origin*, is leavened with a full share of present *physiological and morphological meaning.*

These phases of classification are well illustrated by the biological sciences. The use of simple and conspicuous characters led to the classification of plants into trees, shrubs, and herbs, an arrangement still popularly clung to. Cæsalpinus (1583) slightly amplified this into trees, undershrubs, and herbs, and flower and seedless plants. So in the world of animals, the beasts, birds, fishes, and creeping things of the Mosaic philosophy, groups which differ from one another in conspicuous features of appearance and mode of life, these are the first formed divisions, and to this day the vast proportion of humanity to whom it is known would regard the whale as a fish because its habit of life appears to resemble that of fishes.

Coming to distinct attempts at classification, we find the "one attribute" principle, or, at the most, simple departures therefrom, first in use. This is peculiarly the case with the vegetable kingdom. The corolla, the fruit, the calyx and corolla, and the stamens and pistil have provided by their modifications the principles for classification. The last of these, in the well-known Linnæan system, is still in wide popular use. But of these early attempts at classification many of the secondary groupings are much more philosophical, as for example is that of Ray. In classification, the old battle of the Aristotelian *versus* the Baconian philosophy has had to be fought out. The earlier systems were all Aristotelian in principle; some are more or less so still, while the ultimate classification must be on Baconian lines; the units must be studied before the groups, the groups before the classes. *Accurate classification works upwards.* For long the ultimate form of vegetable classification given by Spencer has been superseded, and for the last score of years or more English botanists at any rate have abandoned attempts to make systems, and have devoted their attention to the practical application of the law italicised above, by the study of the units of the vegetable kingdom, and attempting then to define the limits of genera.

In all modern systems of classification, the linear arrangement has disappeared, and instead of it appear groups and sub-groups whose relations with one another are very various, and dependent on internal as well as external organisation, on organs as well as on members. And the marked tendency of modern classifications is to base the widest groupings on points of physiological, the narrower of morphological importance. Internal organisation is of higher classificatory importance than external form. The newest tendency throws things still further back. Believing that the early history of an individual shadows the past history of its race, the modern systematist becomes more and more embryological, and here the Baconian philosophy must of needs have fullest play. One thing is clear. Linear arrangements are things of the past.

METEOROLOGICAL NOTES.—May, 1885.

Atmospheric pressure was unsteady throughout the month, though the range was not large. The barometer attained its highest point, 30·207 inches, on the 12th. The past month was remarkable for its low mean temperature—above 4 degrees lower than the average. The minimum was below 40 degrees on sixteen nights, as against ten in 1883 and 1884; while the maximum reached 60 degrees on only seven days, as compared with seventeen in 1883 and nineteen in 1884. The highest readings were registered on the 28th, and were 71·2° at Loughborough, 70·8° at Hodsock, 69·9° at Strelley, 68·5° at Coston Rectory, and 68° at Henley-in-Arden. In the rays of the sun, 130·1° at Loughborough, 126·2° at Hodsock, and 125·6° at Strelley, also on the 28th. The lowest readings were 27·9° at Hodsock, 28·5° at Coston Rectory, and 29° at Henley-in-Arden, on the 12th; 30° at Strelley, on the 7th and 8th; and 30·9° at Loughborough, on the 7th. On the grass, 19·4° at Hodsock, on the 7th; 24·2° at Strelley, on the 8th; and 25° at Loughborough, on the 12th. Rainfall generally was below the average, excepting at Henley-in-Arden, where the observer reports it to have been 1·16 inches in excess of the mean of fifteen years. The amount at that station was 3·59 inches; at Strelley, 1·97 inches; Loughborough, 1·87 inches; Coston Rectory, 1·83 inches; Hodsock, 1·73 inches. The number of "rainy days" varied from twenty to twenty-one: the heaviest falls from 0·64 to 0·30. Snow fell at Henley-in-Arden on the 5th and 7th. Lightning and thunder were observed at Loughborough on the 17th and 21st. Sunshine was deficient.

Wm. Berridge, F.R. Met. Soc.

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Reviews.

Ordnance Atlas of the British Isles, with Plans of Towns. Price 35/- Published by G. W. Bacon, 127, Strand, London.

This magnificent atlas is, beyond all question, the best of its kind with which we are acquainted. It includes index maps of England, Wales, Scotland, and Ireland; forty-nine maps of the English counties (double maps being devoted to the large counties); large-scale maps of Wales, Scotland, and Ireland—each in four sections; an excellent (double) geological map of England; twenty-three large-scale plans of towns; eight maps of environs of towns; and, finally, five maps of the Isle of Man, Isle of Wight, Channel Isles, Orkneys and Shetlands, and the Lakes of Killarney. The extensive alphabetical indices contain more than 50,000 names; the introduction includes fifty-four pages of valuable letterpress.

The great merit of the work, of course, lies in its being an accurate reproduction of the Ordnance Survey. The large scale of the maps—which are about 16in. by 12in.—permits of every detail being shown, and for clearness of roads and railways this atlas is unsurpassed. The plans of the towns are from the Government Surveys, which have only just been completed; and the idea of issuing maps of the environs of the large towns, showing the country for twenty or thirty miles round, is a very happy one. All the maps are beautifully printed in colours on thin tough paper on guards, while the binding is excellent. Altogether this is a book which we can strongly recommend.

Photo-micrography. By A. C. Malley, B.A., F.R.M.S. Second edition. Sm. 8vo., 166 pp., 3 plates, 28 woodcuts. Price 7/6. Published by H. K. Lewis, Gower Street, London.

This very useful book is the only one published—in England at all events—upon the subject, and the fact that it has so soon reached a second edition proves its usefulness. It includes a description of the apparatus required, suitable methods of mounting, the wet collodion and gelatine dry-plate processes, with an account—well illustrated—of the arrangement of the apparatus for photo-micrography, and a dissertation on the faults most commonly met with, and their remedies. The plates include photo-micrographs of various diatoms—enlarged from 1,000 to 1,500 diameters—physiological slides, butterfly scales, &c. Altogether the book is a suggestive and a useful one, and we commend it to the rapidly increasing class of our readers who have taken up the study of photography.

Leafing of Oak and Ash.—During the month of May last the foliation of many hundreds of these trees was observed in Bedfordshire and Hertfordshire. It was not till the third week that the oak trees were well expanded, and the ashes as a whole were several days later. Some of the latter were not in full leaf till quite the end of the month. There were a few instances, possibly five per cent., in which the ash trees, in similar circumstances with oak trees, were equally advanced with them. These were, probably, especially vigorous trees. This is now the sixth consecutive season in which the leafing of these trees has been relatively the same. J. Saunders.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, May 26th.—Mr. Beale, of Rowley Regis, exhibited various specimens from calciferous sandstone, carboniferous limestone, Yoredale rock, coal measures (lower) not local; coal measures, local. Plants: mollusca, crustaceans, and icthyolites of unknown or little-known species. Also, spotted coal. Mr. A. H. Atkins, Silurian specimens from Purlieu Lane, Malvern, which in the space of less than a mile shows sections of all the Upper Silurian Beds. Fossils: *Pentamerus oblongus*, *Stricklandinia lirata*, *Orthis lunata*, *Rhynchonella nucula*, *Lingula Lewisii*, *Avicula Danbergii*, and *Phacops caudatus*.—June 2nd.—Mr. T. Bolton exhibited young lampreys just hatched from the eggs; also *Notommata brachionus* from King's Norton. Mr. W. B. Grove, B.A., then read an interesting paper on "A Botanical Tour on a Laburnum Leaf," which he illustrated by coloured diagrams and mounted sections under the microscopes. He also exhibited the microscopic plants themselves, viz.: *Leptosphæria Lucina* (new to Great Britain); also *Glœosporium cytisi*, *Phyllosticta cytisi*, *Alternaria brassicæ*, *Cladosporium fasciculare*, *Epicoccum neglectum*, and *Fusarium roseum*, all on laburnum leaves from Bradnock's Marsh, Hampton-in-Arden. The paper also offered evidence in favour of the modern tendency to found the species of parasitic Fungi on a narrow biological basis, even where no difference of form existed.—Biological Section, June 9th.—Mr. Charles Pumphrey exhibited a beautiful selection of Swiss alpine plants, cultivated in his garden from roots gathered in Switzerland; Mr. T. Bolton, F.R.M.S., a gelatinous ring of green ova, probably of a water beetle, and *Leptodora hyalina*; Mr. W. B. Grove, B.A., Fungi, *Agaricus sphagnorum*, *A. electicus* (rare), *Peziza Curreiana*, from Sutton Park; Mr. J. E. Bagnall, A.L.S., *Medicago maculata*, *M. denticulata*, *Pyrus Aria* (all rare), and a moss, *Fontinalis antipyretica* (in fruit), first time observed in fruit in Warwickshire. all from Weddington; and for Rev. D. C. O. Adams, The Morrell, *Morchella semilibera*, from near Coventry, with microscopical preparations to show asci and spores.—At the Sociological Section's meeting on the 4th instant, Miss Naden read chapter vi. of Mr. Herbert Spencer's "Study of Sociology" on "Subjective difficulties—Intellectual," followed by discussion and elucidations joined in by Mr. W. R. Hughes, F.L.S. (Chairman of the Section), Dr. Carter, Mr. C. H. Allison, and others.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 1st. Mr. Beale exhibited some of the rarer fossils of the Wenlock limestone of Dudley, including specimens of *Eichwaldia capewelli*, *Avicula mira*, *Cyrtia*, &c. Mr. Deakin, a collection of fossils from Cheltenham. Mr. Madison, the black slug, *Arion ater*, var. *abalateralis*. Under the microscope, Mr. Tylar showed a palate of *Trochus zizyphinus* stained in two colours.—June 8th. Mr. Rodgers showed a collection of minerals from the Rowley Regis quarries. Mr. Delicate, a photograph of a fault in the quartzite at Rubery. Mr. Madison, specimens of *Helix revelata* from Jersey, and some large specimens of *Ancylus fluviatilis* from Yardley Wood. Mr. J. Betteridge, a collection of birds' nests and eggs, including two of the chaffinch; the eggs in one were of the normal colour, while in the other they were pale blue without spots. A nest of the dormouse was also shown.—June 15th. Mr. Madison exhibited a case of *Helix aspersa*, showing numerous variations in colour and size. Mr. Hawkes, *Æcidium tragopogonis* and *Ustilago receptaculorum*, both on the goat's beard. Mr. Tylar, an early work on the microscope, by Henry Baker, quaintly illustrated, and dated 1769. Under the microscopes, Mr. Moore showed jaws of helices; Mr. J. W. Neville, wing of butterfly, *Morpho cypris*. A paper was then read by Mr. H. Insley on "The extraction and mounting of molluscan palates," which described the anatomy of the garden snail, whelk, &c., the best means of extracting the palates, and the most suitable media for mounting, glycerine being generally preferable for those not requiring polarised light. The process of dissection was shown.

CARADOC FIELD CLUB.—The first excursion of the season was made to the Titterstone Clee Hill, near Ludlow, on the 19th ult. The party assembled at Ludlow and proceeded by carriages through some of the most beautiful scenery of South Shropshire to the village of Bitterley, situated at the foot of the hill to be ascended. Here the church, with its fine Norman font, its ancient oak chest, its carved oak pulpit of Jacobean date, and its many interesting monuments, was inspected, under the guidance of the venerable Rector, assisted by Sir Charles Rouse Boughton, Bart. In the churchyard stands a remarkably fine cross, attributed by some authorities to the year 1500, by others to the time of Richard III. The party was then invited to inspect the garden and house of the Rector, who exhibited a most interesting collection of ancient deeds, books, pictures, &c., the accumulation of many centuries by the members of this ancient Shropshire family. After partaking of the hospitality of their kind host, the party proceeded to the proper work of the day, viz., to investigate the natural features and productions of the hill, which rises boldly to the height of 1,754 feet, the summit being crowned by an ancient encampment, whence may be seen a magnificent panorama embracing parts of Herefordshire, Radnorshire, Montgomeryshire, and Worcestershire. At this point the President, the Rev. J. D. La Touche, delivered an able address on the geology of the hill, which we hope to give *in extenso*, illustrating its formation by that of Graham's Island in the Mediterranean, which was thrown up by volcanic agency in modern times. After inspecting the exposure of columnar basaltic rock, visiting one of the coal pits, and collecting abundant fossils, the party returned to Ludlow, highly satisfied with the day's excursion.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. MONTHLY MEETING, Wednesday, June 17th. The Chairman reported that on the field day on the previous Wednesday ten members went to Broughton Station, walked four miles by Cosby, and returned from Countesthorpe Station. A few of the less common plants were found, but nothing remarkable. Search was made, but in vain, for the true *Cerastium semidecandrum*. The chairman also reported that he had been invited to visit the Osier Grounds belonging to Messrs. Ellmore and Son, the well-known Leicester basket manufacturers, in order to give an opinion as to the cause of a serious blight which had destroyed £400 of young trees. He found about sixty acres planted with willow stools, of about forty different varieties—a most interesting and remarkable collection. Many had been imported from various countries, and each was considered to have its own particular value for certain kinds of work. The blight appeared to have been caused by myriads of black aphides, which covered the young shoots last summer, leaving a black stain on the bark of the withered and exhausted twigs. The stools being mostly only two years old, were unable to bear the drain of sap extracted by the aphides, and either died during the autumn or failed to put out fresh shoots after the rods were cut in the winter. He had advised the proprietors to employ a man at once to go through the whole nursery with a basket, cutting off every twig on which an aphis could be found, before they should have time to multiply again to any formidable extent. The following objects were exhibited:—By Miss Adderly, a living specimen of *Sedum rhodiola*, in flower, from the Isle of Skye; by Mr. E. F. Cooper, F.L.S., a living specimen, in flower, of *Orchis ustulata*, from Beachy Head, and a fine truss of the very elegant flowers of *Kalmia latifolia*, showing the curious manner in which the elastic stamens are held back until ripe in pockets of the corolla; by Dr. Cooper, a specimen of *Hippocrepis comosa*, from Eastbourne; by the chairman, a mass of algæ from one of the waterworks reservoirs, which Mr. F. Bates stated, after examination, consisted chiefly of *Spirogyra longata*, *Weberia tenuissima*, and *Calospora*, with various desmids, diatoms, and bacteria. Miss Iöns, of Craven House, Princes Road, was elected a member of the section.—The Chairman read a paper on "The Campanulas of Leicestershire," illustrated by dried specimens of all the British campanulas, and drawings of the reproductive organs of *C. glomerata*, showing the peculiar manner in which the anthers deposit their pollen on the hairy style. He also reported that the Council of the Society had passed a resolution inviting the sections to send in papers for publication in the Society's transactions *in extenso*, instead of in brief abstract as before. This was an important change, and would place the Society on a footing which it had never hitherto held, as one of those which publish "Transactions" in the technical sense.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 188.)

SOME SECTIONS ILLUSTRATING THE DEVELOPMENT OF THE "MARGARITATUS" ZONE IN NORTHAMPTONSHIRE.

The number of sections in which the "Margaritatus" Zone can be studied is not large, but the beds of which the zone is made up are as interesting, palæontologically, as any in the Middle Lias. The section given below cannot now be seen; it was worked a short time for stone, and then covered up again. The situation is on the side of a steep hill overlooking Banbury, about a mile or more from Chalcomb, and quite away from any road.

SECTION NEAR TO GIBBARD'S FARM, CHALCOMB.

			Feet.	In.
"Margaritatus" Zone.		1.—Soil and light-coloured clay	3	0
	K.	2.—Sandy clay or shale, light brown colour, micaceous and ferruginous, joints red ...	2	3
	K.	3.—Band of ironstone concretions, with some small pebbles, containing:—*Modiola*, *Astarte striato-sulcata*, *Arcomya hispida*, *Pecten æquivalvis*, *Avicula inæquivalvis*, *Small ammonites (probably A. margaritatus)*	0	9
	K.	4.—Sandy clay or shale, light brown colour, highly micaceous, joints and surfaces reddish. No effervescence with acids:—*Ammonites margaritatus (small specimens)*, *Avicula inæquivalvis*, *Pecten æquivalvis*, *Pecten liasinus*, *Modiola*, *Protocardium truncatum*, &c.	2	7
	L.	5.—Hard calcareous rock, mottled in places, and containing much crystallised carbonate of lime. Highly fossiliferous, but the fossils difficult to extract or identify in the stone:—*Ammonites sp.?* *Ostrea*, *Limea acuticosta*		
		Good spring of water.		

The hard bed, No. 5 ("L" of typical section), contained some very pretty pieces of stone, pieces full of little cavities partially filled with crystallised carbonate of lime (congealed water as the people there told us), the remainder of the stone being a bright orange or red colour. Our attention was directed to this quarry by noticing the pieces of variegated stone preserved as ornaments at the village inn. It was not possible to measure the bed No. 5, but I should scarcely think it is more than two feet in thickness, because a good spring issues from the side of the hill very little below the level of the exposed part of the bed. There are several good springs around at about the same level, and evidently coming from the same bed.

I know of no other sections in the neighbourhood of Chalcomb in which the beds described above can be now seen, but they have been exposed at MIDDLETON CHENEY, and the lower one was worked for road metal some years ago at WARKWORTH and OVERTHORPE.

The beds 2, 3, and 4 I have classed together as "K;" the band of ironstone nodules has been found nowhere else.

All the Middle Lias sections I have been able to discover between Chalcomb and Byfield exposed the "Spinatus" Zone only, and so for the present I pass them by. At BYFIELD, however, there is a very complete development of the Middle Lias beds we are considering. On the EAST AND WEST JUNCTION RAILWAY, extending from near Aston-le-Wall to Byfield, are several sections of the Middle and Upper Lias. The whole of the beds from the "*Communis*" *Zone* of the Upper Lias to the base of the "*Margaritatus*" *Zone* of the Middle Lias have been exposed, though only the hard beds above "I" can now be seen. The complete section will appear later on, but I may say that the bottom hard bed "L" was found, and that there are some springs in the neighbourhood much below the level of the rock-bed, which in all probability issue from the base of this bed "L."

Along the valley between HELLIDON and CATESBY there are some exposures of the lower beds of the Middle Lias by the side of the brook. In the part of the valley near to Hellidon, where a little fall of water occurs, the side of the brook is composed of a blue micaceous clay containing a few fossils (only *Limea acuticosta* identified), and in the bank, some fifteen to twenty feet above, a very light brown rock may be seen, but no fossils could be detected on the occasion of my visit. A little further along the brook, and at about the same level as the micaceous clay above noticed, are some very large pieces of rock very much like the rock-bed of this neighbourhood. The former beds must be near the base of the "Margaritatus" Zone, and I expected to find that these large blocks of stone were the bottom bed, but there were no fossils to be seen, and moreover the stone could only be found at this one place. They are probably pieces of the rock-bed that have got there by accident. The bed "L" is apparently absent for a considerable distance along this valley, for a few months ago I found a heap of material that had been recently thrown out in deepening the brook for a sheep wash, and there was no trace of a hard bed.

There are two other sections, nearer DAY KNOWL, where a light grey clay is succeeded abruptly by a dark blue clay or shale, and these are commonly supposed to show the junction of the Middle and Lower Lias (Survey division).

Between Catesby and Staverton there are no sections to be seen in the valley, but the base of the beds I am here describing can be traced by the numerous springs which issue from the side of the escarpment. On the west of STAVERTON there is a rather steep lane, and at the bottom of it a good section, exposing the lower beds of the "Margaritatus" Zone.

SECTION AT STAVERTON.

	Feet.	In.
G. 1.—Soil and light-coloured sandy bed, not so micaceous or fossiliferous as the soft beds below. Not well exposed	3	0
H 2.—Soft, porous sandstone or limestone, very ferruginous, containing many fossils:—*Protocardium truncatum (abundant), Avicula inæquivalvis, Pleuromya costata, Pholadomya ambigua, Pentacrinite stems, &c.*...	2	9
I. 3.—Sandy micaceous clay, ferruginous in places, containing:—*Pecten liasinus, Limea acuticosta, Protocardium truncatum, &c.*	4	0
J. 4.—Calcareous and ferruginous sandstone, interior of bluish or slaty colour, containing:—*Protocardium truncatum, Limea acuticosta, Pleuromya costata, Pentacrinite stems, Fucoids (abundant)*	2	0
K. 5.—Sandy clay, light coloured, micaceous and ferruginous, containing a fair number of fossils, but these mostly casts	5	9
At this point a STRONG SPRING issues from the rock, and has cut deeply into the next bed.		
L. 6.—Hard fossiliferous limestone, ferruginous, in places made up of fossils, in others cellular, the cavities being lined with crystals of calc spar. Some parts of the face covered with deposited carbonate of lime, making it almost like a stalactite in appearance. Containing:—*Belemnites, Pecten æquivalvis, Pecten liasinus, Limea acuticosta, Protocardium truncatum, Astarte striato-sulcata, &c.*	1	4

7.– Hard blue clay—depth unknown.

The section is probably twelve feet or more deeper, but so covered up that nothing more could be made out.

In a lane to the north of Newnham one of the soft beds of the "*Margaritatus*" *Zone* may be seen. Judging by the condition of the bed, and the fossils found in it, I consider it to be either "I" or "K" of the typical section. It is light coloured, micaceous and ferruginous, and contains:—*Ammonites margaritatus*, *Pholadomya ambigua*, *Limea acuticosta*, *Pentacrintes*, and *Fucoids, &c.*

There is a small stone pit on the road leading from Daventry to Braunston, about a mile-and-a-half from Daventry, which presents some features I have not noticed elsewhere. Below is the section.

Section near to Daventry.

	Feet.	In.
1.—Soil containing many pebbles from the drift ...	1	6
2.—Irregular sandy bed, containing many pieces of fossiliferous stone, fragmentary and waterworn. The fragments seem to contain fossils from at least three of the higher beds, but particularly from "F" and "H." Fossils: — *Ammonites spinatus*, *Terebratula punctata*, *Terebratula Walfordi* (*a single specimen of each*), *Belemnites*, *Turbo*, *Avicula sp.? (very abundant)*, *Avicula inæquivalvis*, *Limea acuticosta*, *Pecten liasinus*, *Protocardium truncatum*, *Modiola*, *Ostrea cymbium*, *&c.* ...	1	6
3.—Hard compact rock, like that found at the base of the "Margaritatus" Zone at Chalcomb and Staverton. Very many fossils, but the stone so hard that few could be got out:—*Belemnites (very abundant)*, *Pecten æquivalvis (large)*, *Pecten liasinus (large)*, *Ostrea*, *Pleuromya*, *Protocardium truncatum*, *Limea acuticosta*, *&c.* *No Rhynchonellæ or Terebratulæ.* Thickness, one foot three inches...		
4.—Hardened, sandy, micaceous bed, could detect no fossils. Thickness, two feet six inches ...	3	9

Beds 3 and 4 in the above section can only be separated by a close examination; at a very slight distance away they appear like one block of stone only. I believe bed No. 3 is "L" of the typical section, but have never seen a bed like No. 4 underlying it elsewhere.

A little way out of Daventry, on the Welton Road, two or three of the lower beds of the "*Margaritatus*" *Zone* may be seen. About a quarter-of-a-mile along this road the banks are very steep and rather high, and near the top is a moderately hard, shaly, highly micaceous bed, which is easily identified as "J" of the typical section; it contains: *Protocardium truncatum, Pleuromya costata, Limea acuticosta,* and *Fucoids (abundant.)* Below this is a reddish, micaceous, sandy bed, like bed "K," everywhere in the district. A little further from Daventry, just over the ridge of the hill, another hard bed is found in the bank; it is shaly, weathers rather white, contains very little mica, and much more resembles "F" than "H." No fossils were obtained, although parts of it seemed to be made up of comminuted shell. Apparently bed "H" ceases to exist as a distinct hard bed in this neighbourhood, for I have not found it in any section further north.

Several Middle Lias beds may be seen on the railway near to Watford Lodge, a description of which will appear later on.

I believe the junction of the Middle and Lower Lias may be seen in a brook near to Elkington, but if so the bottom bed is absent. This is not surprising, because the whole of the Middle Lias is very much attenuated here, the rock-bed itself being very indifferently represented.

(To be continued.)

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from page 201.)

Upon the surface of the scala media lie several important structures.—1. On the side towards the tympanic scala is the very elastic Basilar Membrane upon which stand about 3,000 club-shaped fibres arranged in pairs forming arches. These fibres are called the Rods of Corti, and are thought to contain at least one nerve filament each.—2. Over these rods is the Membrane of Corti containing numerous cells of various shapes, and 3. On the partition separating the scala media from the scala vestibuli is the membrane of Reissner. Wandt believes that different tones affect different parts of the nerve of hearing thus disposed, and that, as elastic bodies respond each to some particular tone, and remain quiescent when other tones are sounded, so the elastic tooth-shaped pairs of rods of Corti, together with the superposed laminæ, are divided into groups responsive only to the stimuli of given notes, so that every fraction of a tone which a well-trained ear is capable of recognising is represented by its separate nerve fibre. Thus it is thought the fibres of Corti are like tuning forks, set vibrating each by a particular sound wave, and that each affects a particular fibre of the cochlea nerve only. It must be understood, however, that this explanation is only hypothetical, and still awaits definite proof.

It will be seen that two of the cochlear scalæ receive vibrations directly from the vestibule, viz.: the scala vestibuli from the perilymph, and the scala media from the endolymph. The scala tympani has been supposed by some to receive vibrations through the fenestra rotunda directly from the tympanum; whilst by others it is thought more likely that vibrations descend it after having passed the scala vestibuli. I should conclude that it is affected in both these modes, though but slightly by the first.

The auditory nerve, called from its softness the *portio mollis* of the seventh pair, is marked by the fineness of its component fibres. It enters the labyrinth by the internal meatus, where it subdivides into two branches, one supplying the vestibule, and the other forming the cochlear nerve. The ultimate terminations of the nerve-fibres in the cochlea have not yet, I think, been definitely traced, though it is almost certain that some of them end in the organ of Corti.

Having now sketched the anatomy of the organ of hearing, it remains for us to consider a little more in detail some parts of the physiology of hearing not noted in connection with the foregoing anatomical considerations. According to popular conception the pulsations of air upon the tympanic membrane are the necessary antecedents of sensations of sound; but this appears to be disproved by the following:—A *drum* is silent if the skin be burst, because the skin is its only effective vibrating surface; but the tympanum is not properly a drum, inasmuch as its membrane may, according to Cheselden, be burst, not only without destroying hearing, but even in some cases with a terrible *increase* in susceptibilty to sounds. Cheselden destroyed the membranes in dogs, and found that they were terrified at all loud sounds; and there is a case on record of a man with a hole in his tympanum, to whom the whistling of another man in an adjoining room was intolerable (G. H. Lewes).

Still it is clear that the vibrations of the tympanic membrane are of great assistance in hearing, as it is found that a thickening, or stiffening of it, or even unusual dryness, will render hearing dull. Many a temporary deafness has been removed by well syringing the ear with warm soap and water (although in such cases the removal of indurated wax, which had occluded the external canal, may often count for more than the lavement of the membrane), or by removing the obstruction caused at the pharyngeal end of the eustachian tube by the congestion of the surrounding tissue, the accumulation of mucus, &c., and thereby facilitating the vibration of the membrane.

Against this statement that the tympanum is not really a drum Dr. Edward Clarke (quoted by Brown Sequard, "Journal de la Phys.," i., 644) adduces his observations of seventy-five cases of perforated membranes, with the following results:—

Tick of watch not heard in	5 cases	Normal limit of hearing about 14 ft. (Clarke.)
Only heard when close to ear	11 ,,	
Only within distance of 6 to 12 inches,	16 ,,	
Only within 4 feet	43 ,,	

There is, however, a source of fallacy in these valuable observations—It seems to have been forgotten that only one tympanum was perforated in his subjects, and therefore, if there were no other aural defects, they ought to have been able to recognise the tick of a watch with the sound ear anywhere within 14ft. If they could not, their defective hearing might reasonably be attributed to causes other than a perforated tympanum. [The watch used in the experiment must have been one of the portly forms worn by our great grandfathers.]

The *modus operandi* of hearing may be summarised somewhat as follows. The aerial waves proceeding from the vibrating body are collected by the pinna of the ear, focussed by the concha, and conducted into the external meatus, where they strike upon the tympanic membrane, producing vibrations in it. The vibration of this membrane causes the process of the malleus attached to it to swing at the same rate; the head of the malleus consequently turns through a small arc on its pivot (the *processus gracilis*). But the turning of the head of the malleus involves that of the head of the incus upon its pivot (the short process). Hence the long process of the incus swings through an arc estimated as about two-thirds that described by the handle of the malleus, the decrease in the extent of the push being compensated for by a proportional increase in force, which is an advantageous change in so confined a space as the tympanum. The long process of the incus being articulated with the stapes, involves this bone in its movements, pulling it out of and pushing it into the fenestra ovalis with equal rate and force. But every pull and push of the stapes imparts a corresponding set of shakes to the perilymph, which fills the bony labyrinth and cochlea external to the membranous labyrinth and scala media. These shakes are transmitted to the endolymph through the membranous envelope, and by the aid of the otoconia (or otolithes) and fibres of Corti are finally converted into impulses, which act as irritants of the ends of the vestibular and cochlear terminations of the auditory nerve.

The labyrinthine fluids are, it would seem, also in a measure agitated by sound waves travelling through all parts of the skull (though most of these are, doubtless, so dissipated as to produce no appreciable effect). As examples of sounds transmitted through the skull we may quote the well-known case of applying the stem of a vibrating tuning fork to the teeth, &c., and the production of "big bells" by the kitchen poker, suspended from a string, held at each end by the index finger closing the entrance to either ear. An eminent London Aurist also quotes, as an illustration, the opening of the mouth in cases of rapt attention to a discourse, music, &c. He considers that in this state hearing is assisted by sound waves being able to reach the tympanic cavity through the eustachian tube, and thus compares it to the cetacean "backward" hearing, noted above. I should also consider this as an example in point, although, in common with the relaxation of other members in states of rapt attention, &c., it may also be explained by reference to the effects of absorbing object regards, and is noticed in cases of concentrated attention generallv,—but, as the pharyugeal end of the Eustachian tube is almost closed by its projecting lips, except during swallowing, and the soft palate offers an obstacle to the passage of sound waves. I should be more inclined to attribute any improvement in hearing in this case to the transmission of saund vibrations through the teeth.

The character of sound sensations of course depends greatly upon the nature of the originating vibrations, whether rapid or slow, intense or delicate.

The three physical peculiarities of sonorous impressions are:—

I. *Intensity* and *Quantity*—loudness or feebleness, and volume of sound.

II. *Pitch*—or note sounded.

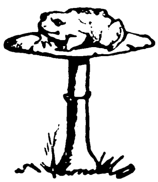
III. *Quality*, *timbre*, or *klang*—the difference between sounds of the same pitch proceeding from different sources.

I. *Intensity*, supposed to be discriminated by the parts of the labyrinth other than the rods of Corti, depends directly upon the degree of stimulation. Above a given point the effect becomes pungent, like the action of ammonia on the nose, and may, to fresh and vigorous nerves, give pleasurable excitement for a time; but when long continued, or rising still higher, the sensation becomes painful, *e.g.*, the screeching in a parrot house, the shrill barking of small dogs, the whistling of boys in the street, the sharpening of a saw, &c. In most of these cases, however, the element of dissonance unites with the smarting of the sound.

(To be continued.)

THE LEICESTERSHIRE FORMS OF *CAPSELLA BURSA-PASTORIS*.*

BY F. T. MOTT, F.R.G.S.



Capsella Bursa-Pastoris is one of the commonest weeds in all parts of Europe, and has spread itself over at least one-third of the habitable globe. Being an annual, very hardy, flowering at nearly all seasons of the year, and ripening its seeds abundantly, it has every chance of perpetual hybridization, and its "forms" are as numerous as those of *Cratægus oxyacantha*. Some of these forms will probably in the course of future ages become isolated under special conditions, will diverge further from the type, and will ultimately settle down into distinct species. At present, I do not think that any of the European forms can be regarded as more than varieties. A few of them may be fairly distinguished by certain extreme characters, but they are all linked together by innumerable intermediates, and probably no one of them would come true from seed sown under varying conditions. Koch, in 1843, made four varieties from the shape of the root-leaves. Jordan, in 1864, described six forms which he considered to be good species, distinguished partly by the leaves and partly by the flowers and capsules. Crépin distinguished three varieties by the capsules alone; and lastly, Mr. C. P. Hobkirk, now of Dewsbury, a well-known and very acute botanist, published in 1869 a memoir upon the genus *Capsella*, in which he admits six *sub-species* founded on the flowers and capsules only. Mr. Hobkirk has generously placed in my hands a copy of his memoir, from which I have derived

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read October 15, 1884.

much information, and a fasciculus of specimens, and tells me he now thinks that some regard should perhaps have been paid to the variations of the root-leaves. Mr. Hobkirk's descriptions are full and clear, but as he remarks that he does not find his specimens to agree precisely with the diagnoses of M. Jordan, so I find that my Leicestershire specimens do not quite tally with the descriptions in Mr. Hobkirk's memoir. This seems to be a further indication that these "forms" are of a temporary and uncertain character, much influenced by local conditions.

Taking into account both the leaves and capsules, I find among a considerable number of specimens collected in this county the following extreme forms sufficiently distinguishable, while the rest run in between them with a complexity of cross characters forming a confused network which defies classification.

Section A.—Radical Leaves mostly Lyrate or Pinnatifid.

Var. 1.—*Gracilis.* Radical leaves rather thin, toothed, lyrate or pinnatifid, capsule small, obovate, notch none.

Var. 2.—*Densifolia.* Radical leaves firm, short, closely pinnatifid in a dense rosette, capsule forming nearly an equilateral triangle, notch shallow, lateral margins convex. On walls and in dry places.

Var. 3.—*Stenocarpa lyrata.* Radical leaves thin, toothed or lyrate, capsule long, narrow, obovate, notch moderate, lateral margins convex, lobes not divergent.

Var. 4.—*Stenocarpa coronopifolia.* Radical leaves thin, pinnatifid, pinnæ acute with the front margins toothed, capsule long, narrow, obovate, notch moderate, lateral margins convex, lobes not divergent.

Var. 5.—*Brachycarpa.* Radical leaves rather firm, toothed lyrate or pinnatifid, capsule forming an equilateral triangle, notch shallow, lateral margins straight. This may perhaps be the typical form.

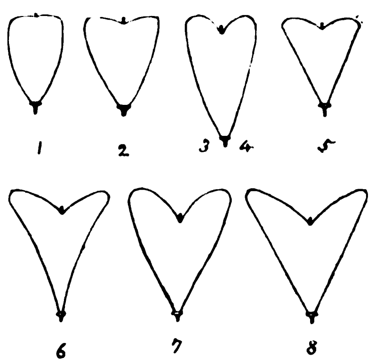
Section B.—Radical Leaves mostly Entire or Toothed, rarely Pinnatifid.

Var. 6.—*Rubellæformis.* Radical leaves rather firm, entire or toothed, capsule forming an isosceles triangle, notch moderate, lateral margins concave, giving to the lobes a slightly recurved appearance. In the true *rubella* the recurved character of the lobes is more distinctly marked.

Var. 7.—*Macrophylla*. Radical leaves thin, pale green, 3in. to 6in. long, ½in. to 1in. broad, lanceolate or ob-lanceolate, entire or toothed, capsule forming an isosceles triangle, large, notch deep, lateral margins slightly convex, lobes not very divergent.

Var. 8.—*Bifida*. Radical leaves thin, scarcely so large as in the last, almost entire, capsule large, forming an isosceles triangle, notch deep, lateral margins straight, lobes widely divergent.

The annexed cut shows the seven forms of the capsule.



For some of the above forms I have adopted names which have been already used to represent the same leading characters. The names of *densifolia*, *lyrata*, *brachycarpa*, and *rubellæformis* have not been hitherto in use in this genus, but they express to some extent the principal features of certain extreme forms in my collection.

In admitting so many as eight distinct forms I have simply followed Nature as she appears in the examples before me. After sorting these out repeatedly, I find these eight extreme types clearly distinguishable, while in the rest the various characters seem to be promiscuously combined.

I think the characters I have given are sufficiently obvious to make it easy for other botanists to correlate their specimens, and it would be very instructive to know how the forms which may be common in other counties tally with those of Leicestershire. One remarkable character seems to be deducible from a study of these forms, viz.: that in this genus there is some connection between the notching of the capsule and the toothing of the leaves. Where the leaves are deeply cut the notch of the capsule is comparatively shallow, and where the leaves are entire the notch is deep.

The notch depends upon the elongation of the upper extremities of the two valves of the capsule, which elongation takes place mostly after the fading of the flower. In the young capsules the notch is always less marked. Now an entire leaf generally indicates greater vegetative energy than a divided one, the divisions being probably caused by a deficiency of material. A vigorous form, therefore, will have a tendency to entire leaves and ample growth of capsule, the lobes elongating freely and producing a deep notch.

The length of the style, and the minute variations of the calyx, which are used by some writers in characterising the varieties of *Capsella*, do not seem to me of much practical value.

That the variations are not mostly due to varieties of soil is evident from the fact that of these eight forms, all but 1 and 2 may be found growing intermixed in my own kitchen garden. *Densifolia* may be a stunted form peculiar to dry situations, and *gracilis* is supposed by Jordan to be a barren hybrid, its small undeveloped capsules being generally sterile.

THE GEOLOGICAL STRUCTURE OF THE TITTERSTONE CLEE HILL.*

BY THE REV. J. D. LA TOUCHE.

It is hardly necessary for me to remark, for it is fully admitted by all who have studied the subject, that the rocks which lie scattered around us here, and of which this hill is chiefly composed, are of igneous origin—that they have been at one time in a state of fusion. In fact it is possible to re-melt them, which cannot be done with sedimentary rocks, and some years ago it was attempted to mould this basalt into ornamental form for architectural purposes; but as it was found that the surface soon weathered into an unsightly rusty brown, the project was given up.

It may perhaps be of interest to describe the principal features of these igneous rocks. They are by Sir C. Lyell divided into two chief classes: 1st, those which have been poured out over the surface of existing land, or intruded between strata at no great distance from the surface, or

* An address delivered to the Caradoc Field Club on the occasion of their visit to the Hill, May 19th, 1885.

deposited under water—these he terms *Volcanic*; and 2ndly, those which have been formed at immense depths below the surface, which he names *Plutonic*.

We have before us an example of the first. Of the volcanic class of rocks there are again two main divisions, the *basaltic* and the *trachytic*; the first of these are distinguished by the comparative smoothness of their texture and their breaking with a conchoidal fracture, while the trachytic are rough to the touch owing to the quantity of granular felspar which usually enters into their composition. There is, besides, an important difference in the constituents of them, since, while basalt contains silica or quartz in but small quantity, *i.e.*, something under 50 per cent., trachyte is much more rich in that mineral ranging up to 60 and 70 per cent. And here I may observe that a corresponding difference exists in the two classes of plutonic rocks which correspond to those of the volcanic. Syenite bears much the same relation to basalt which granite does to trachyte. The former is often entirely deficient in silica, whereas in granite its presence is conspicuous. While, however, these distinctions hold as a general rule, a transition from one class to another may often be observed.

The term trap is derived from a Swedish word, trappa, which means a flight of steps; and has been applied to this form of igneous rock from the fact that it frequently occurs in successive terraces, rising above each other in the form of steps. Some seven minerals enter into its composition, viz., silica, alumina, iron, magnesia, lime, potash, and soda. The proportion of these vary considerably, as they do in modern lavas, even in those which have been ejected from the same crater. To account for this fact it has been suggested that when a volcano is in action the lighter portions of the molten rocks, the felspathic trachytes, are first ejected; while the teasor, or the basalt, is the last to make its appearance, issuing in streams pushed through the superincumbent strata, as here.

In many places basalt is seen to assume a distinctly columnar form. This may be observed in those parts of the Clee Hills which are quarried, as well as in the shapes of the numerous blocks which lie around. The number of angles of these prisms varies from three to twelve, but is commonly from five to seven. The dimensions of these columns are very variable. Sometimes they attain a length of 400 feet, sometimes of only an inch or two; their diameter also varying from 9 feet to an inch. It is a remarkable fact that their axis is always perpendicular to the surface on which the lava stream has been deposited, so that—as is well seen in a section of a valley near Ontraigne, in the department of Ardéche, the columnar structure, which is vertical at the bottom of the valley becomes nearly horizontal along its sides. The columnar is not, however, the only form in which this rock is found. In many instances it assumes the appearance of spherical masses resembling cannon balls. I have observed this structure on a very large scale in Natal, where basalt exists through vast tracts of country. An example of the same may also be seen near the Breidden, where also you will find abundant specimens of porous cellular lava, which, when the almond-shaped cavities with which it abounds have been filled by the infiltration of some other material, is called amygdaloid.

You have within the limits of Shropshire good opportunities of studying ancient volcanic phenomena. Corndon is an example of an extinct submarine volcano. All round that hill you find ridges of felspathic ash alternating with shale, telling us of a time when, just as in the present day, showers of stones and ashes are projected from a crater and spread out at the bottom of the sea. A period of rest then takes place, during which the shale (often fossiliferous) is deposited. The Breidden and the Clee Hills, on the other hand, are instance of intrusion; and at Lincoln Hill, near Wellington, you may observe a fine example of a basalt dyke, a mass of molten rock having insinuated itself between the joints of the already deposited strata.

And now a word as to the age and conditions of this outburst of volcanic matter. We are now looking westward across an undulating plain; those successive ridges of hills which you see below us represent the various members of the Silurian formation, and bounding our view to the N.W. you see the Longmynd Hills, the representative of a still earlier epoch, viz., the Cambrian. All these were deposited many ages before the Devonian or Old Red which occupies the nearer ridges, and lastly, the Carboniferous, of which these hills are composed. Finding, then, as we do, that the basalt on which we now stand has spread out over the last-named stratum, the inference is inevitable that its age is subsequent to that of the coal period. That these hills, however, were, as has been, I believe, supposed by some, the site of an extinct volcano is very doubtful; and I quite agree with Mr. Yates, who has studied the subject from a practical point of view, that the evidence is rather in favour of an intrusion of molten matter between the strata, and that the more recent rocks which once overlaid the coal measures have been subsequently removed by denudation. There is every reason to believe that the two Clee hills have been at one time continuous, and that the valley between them has been caused by denudation.

It is not easy to form a very clear idea of the vast natural operations of which I speak, and to some I fear my words may seem to partake of romance and imagination. Yet, you must remember what may possibly be going on at this very moment, unknown to us, in some quarter of our own globe. Sitting, as you are now, among these rocks, amid this peaceful scene, it is not easy to realise the fact that there are spots on the surface of the earth which are the scene of the most violent convulsion; that there are at this moment, in Hawaii, lakes of molten lava some twelve miles long, in a state of fusion, and that, without any perceptible disturbance whatever to this quarter of the earth, only a year or two ago a mountain in Java, some 2,000ft. high, was projected twelve miles into the sea. Again, so lately as the year 1783, a stream of lava issued from Skaptur Jokul, a mountain in Iceland, which, separating into two portions, extended altogether to a distance of ninety-eight miles, filling valleys varying in breadth from a narrow gorge to fifteen miles, and in depth from 100ft. to 600ft. Cast your eyes over the valley which lies beneath us, and fancy a stream of molten matter not only filling it but extending two-thirds as far as London is from here, and thus you may obtain a practical idea of the vast operations which are going on even in the present day.

The question is often asked, what underlies—what are the foundations of all the rocks which compose the earth's crust? and it was long supposed that they must be of igneous origin. Later discoveries have, however, tended to modify this opinion. That our globe has been the gradual condensation of nebulous matter in a state of intense heat, and that immense volumes of molten matter exist within the bowels of the earth there is every reason to believe. Yet we are unable to say of any mass of granite or basalt that in it we behold the primordial floor on which all subsequent formations have been laid down; since sedimentary strata of every age are found penetrated by these volcanic rocks, which have, therefore, been obviously formed subsequently to the deposition of the others. All we can say is that so far as we can judge there are evidences of a series of operations extending to a distance in past time which is practically infinite, and in which the deposition of rocks from water, their denudation by atmospheric agencies, and outbursts of volcanic matter, have gone on concurrently from time to time.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

EIGHTH ANNUAL MEETING, BIRMINGHAM, 1885.

The Eighth Annual Meeting of the Union was held at Birmingham on the 16th and 17th June. Unfortunately the attendance from other towns was but small, although the local Societies had made excellent arrangements for Meetings, Conversazione, and Excursions.

The Council Meeting, held in the Council Chamber of the Birmingham Corporation, by kind permission of the Mayor (Ald. T. Martineau), was attended by fifteen delegates. Reports were read from the Secretaries, Management Committee, and Treasurer. It was resolved that in order to open the way for the admission of such Scientific Societies as are not strictly Natural History Societies, the name of the Union be altered to "The Midland Union of Natural History and Scientific Societies."

After the Meeting of the Council, the President of the Union (R. W. Chase, Esq.) entertained the delegates and a number of other gentlemen at luncheon at the Grand Hotel.

The Annual General Meeting was held (by the kind permission of the Bailiff and Council) in the Examination Hall of the Mason College. In addition to the delegates, there were a number of members and friends present—among them the Rev. H. W. Crosskey, Messrs. W. H. France, Robt. Chase, Miss Taunton, Miss Jermyn, Mrs. Potts, Birmingham; Herbert G. Young, of London; H. Pearce, Stourbridge; E. George, Northampton; H. E. Forrest, Shrewsbury; Rev. W. H. Painter, and others.

The President of the Union, R. W. Chase, Esq., was in the chair, and read a very interesting Address on the work of Natural History Societies, and on some special points in the science of ornithology, of which he is a most assiduous and successful follower. The thanks of the meeting were heartily voted to him for the Address, and he was requested to allow it to be published in the "Midland Naturalist."

The Annual Report was then read and adopted, and ordered to be printed in the "Naturalist." Mr. A. W. Wills then moved, Mr. W. R. Hughes seconded, and it was resolved, that Messrs. A. W. Wills, E. W. Badger, and Professor W. Hillhouse be requested to take steps to circulate the appeal on the subject of the preservation of rare plants which is embodied in the Annual Report.

REPORT OF THE COUNCIL.

Societies in the Union.

During the past year the composition of the Union has undergone but little change. The Shropshire Archæological and Natural History Society and the Oxfordshire Natural History Society have withdrawn from the Union, but the Council is gratified to announce that the Rugby School Natural History Society, which for a short time belonged to the Union and then seceded, has decided to re-enter it, so that the list of the component Societies will now stand as follows:—

Bedfordshire Natural History Society and Field Club.
Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmiugham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Evesham Field Naturalists' Club.
Leicester Literary and Philosophical Society.
Northamptonshire Natural History Society.
Nottingham Naturalists' Society.
Nottingham Working Men's Naturalists' Society.
Oswestry and Welshpool Naturalists' Field Club.
Peterborough Natural History and Scientinc Society.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.
Tamworth Natural History, Geological, and Antiquarian Society.

WORK OF THE YEAR.

Of the Work of the Societies during the year there is little of general interest to report. Most of the Societies publish separate transactions, but we think there is an increasing disposition to use the "Midland Naturalist" for the purpose of publishing observations and suggestions.

The Leicester Literary and Philosophical Society, Section D. (Zoology and Botany), and the Nottingham Naturalists' Society are especially to be congratulated upon the praiseworthy attempt they are making to enable the "Midland Naturalist" to better fulfil one of the purposes for which it was established, namely, to be a means of making more widely known what is being done by the various Societies in the Union.

MIDLAND NATURALIST.

The numbers of this periodical which have appeared since the last report have, we consider, fully sustained or more properly enhanced its reputation, and the editors—Messrs. W. J. Harrison and E. W. Badger—deserve the thanks of all our members for their energy and activity in the office they hold. It is, however, obvious that a still larger number of Societies might, with advantage, contribute to its pages, the amount of matter on hand being still but seldom equal to the monthly demand.

The Council also take this opportunity of thanking those persons, especially the Committee of the Birmingham Natural History and Microscopical Society, to whose kindness they owe the illustrations with which the "Midland Naturalist" has been recently enriched.

The principal articles published in this Journal since the last report are as follows:—

The Preservation of Native Plants, by A. W. Wills; Botanical Notes in connection with the Peterborough Meeting, by Rev. M. J. Berkeley and G. C. Druce; Address of the President, Rev. J. J. S. Perowne, on the Repairs to Peterborough Cathedral; Study of a Lichen from Oban, by W. H. Wilkinson; *Lunularia vulgaris*, by Rev. H. P. Reader; On the Mammals of Leicestershire, by F. T. Mott; On the Zygnemaceæ: a Chapter in the History of Fresh Water Algæ, by F. Bates; A Fungus Foray in the Middleton District, by J. E. Bagnall; Penmaenmawr, by T. H. Waller; Report on Marine

Sponges Dredged at Oban, by H. J. Carter; On the Structure of Mosses, by F. T. Mott; Breaking of the Meres, simulated by an excessive development of *Uroglena Volvox*, by Wm. Southall; *Floscularia mutabilis*, by Dr. C. T. Hudson; On the Best Methods of Studying Botany for Beginners, by F. T. Mott; On the Pre-carboniferous Floor of the Midlands, by W. J. Harrison; On the Development of a Fern from its Spore, by G. C. Turner; Koch's Comma Bacillus, by W. B. Grove; The Lias Marlstone of Leicestershire as a Source of Iron, by E. Wilson; On the Nervous System of Vegetables: Do Plants Feel? by F. T. Mott; The Life-history of a Filiform Alga, by Dr. M. C. Cooke; The Physiology of the Medicinal Leech, by Prof. J. B. Haycraft; Notes on Two Rare Annelids, by T. Bolton; The Ear and Hearing, by W. J. Abel; The Middle Lias of Northamptonshire, by B. Thompson; On the Intercellular Relations of Protoplasts, by Prof. W. Hillhouse; Notes on the Mymaridæ, by F. Enock; Roraima Mountain, by W. P. Marshall. The Flora of Warwickshire, by J. E. Bagnall; The Pilobolidæ, by W. B. Grove; and the Exposition of the Principles of Biology, by various members of the Sociological Section of the Birmingham Natural History Society, have also been continued. The Council are pleased to observe that while most of the old contributors maintain their ground, the names of several new and energetic workers are added to the list.

Darwin Medal.

The subject for the Darwin Prize for this year, 1885, is Geology, and the Management Committee requested the services as adjudicators of the following gentlemen, who all courteously consented to examine and report upon the papers which were eligible for the competition, viz.:—Professor A. H. Green, of Leeds; Professor J. W. Judd, of London; Professor T. G. Bonney, of Oxford; Professor C. Lapworth, and Dr. H. W. Crosskey, of Birmingham.

Mr. C. J. Watson was requested to act as Secretary to the adjudicators. On his report to the Council of the opinions given by the adjudicators it was decided that a medal be awarded to our late Honorary Secretary, Mr. W. J. Harrison.

Prizes for Photography.

The subject of offering prizes for Scientific Photography has been under the consideration of the Committee, but they report that they have decided that the state of the funds of the Union will not permit of such a step being taken at present. The Council, nevertheless, wish to direct the attention of the members to this important branch of scientific work. Although very frequently something more of the nature of a diagram is required for the illustration of a paper, yet they are sure that a good photograph would in many cases prove preferable to any engraving for the "Midland Naturalist."

Some of the Societies of the Union have already derived benefit from the much more popular form of photography available at the present day; and have had the opportunity of seeing photographs taken by members of the Societies during visits to America on the occasion of the meeting of the British Association in Montreal. The tourist who can bring back, impressed on his dry plates, pictures of the natural wonders of Niagara, or of the Yellowstone Park, from the points of view which have specially captivated his own eye, has laid up for himself and his friends a pleasure which published photographs rarely give, while the simplicity and ease of performance of the requisite processes permit him to photograph scenes which, without any such interest as would attract a professional artist, yet by their personal associations, or from temporary causes, have become interesting to himself.

Preservation of Native Plants.

The lamentable results of the unchecked eagerness for collecting rare or specially beautiful plants have already been brought to the notice of the members of the Union by the paper on the subject by Mr. A. W. Wills, in the "Midland Naturalist" for August, 1884. The subject has been under the consideration of the Management Committee at each of its meetings, and as the result the Council recommend that the following appeal be adopted by the Annual Meeting, and that Messrs. A. W. Wills, E. W. Badger, and Prof. W. Hillhouse be requested to take the necessary steps to bring it under the notice of the Natural History Societies of the country and of the public generally.

Appeal.

It is a fact only too evident to the most superficial observer that many of our rarest and most beautiful native plants have already been or are being rapidly exterminated; and it may be assumed that this extermination will be viewed with regret—even with indignation—alike by the student and by the ordinary lover of natural beauty, and that both will be willing to assist, by all available means, in any measures which may afford the prospect of arresting its course.

The Council of the Midland Union of Natural History Societies asks serious attention to the following brief statement of the causes of the rapid destruction of British plants, and of what it ventures to suggest as the best means of mitigating the evil.

These causes appear to be mainly as follows:--

First.—The ravages of professional plant-hunters, who offer to the tourist or to the general public, by advertisement, plants attractive by reason of their beauty or of their comparative or absolute rarity.

The large dimensions which this traffic has assumed are indicated by the number of such advertisements which appear in some of the gardening periodicals, offering ferns from Devonshire, Cornwall, Somerset, the Wye Valley, &c., at from 4s. to 7s. 6d. per 100, in named varieties; *Hymenophyllum tunbridgense* and *H. unilaterale* at 2s. per square foot; various species of Orchis, Saxifrage, &c., at from 2s. to 5s. per 100; Bog Asphodel at 2s. per doz.; or inviting tenders for Primroses and Daffodils at so much per 100,000.

Second.—The operations of Exchange Clubs, the members of which are often asked to supply large numbers of the rare plants of their own districts in exchange for corresponding quantities of those of other neighbourhoods.

Third.—The indiscriminate or careless gathering of plants, often taken with their roots or in seed, by Botanists and their students in the course of botanical excursions.

Fourth.—The reckless gathering of large numbers of specimens by individual botanists.

Recognising that restrictive legislation or police interference are neither applicable nor desirable, the Council believes that it is by the indirect influence of example and the promotion of healthy public opinion that the evil in question can alone be combated.

They therefore earnestly urge the following considerations upon botanists, members of Field Clubs, Natural History and other Scientific Societies, upon all lovers of Nature and upon the public generally:—

First.—That they should rigidly abstain from encouraging or countenancing the purchase from professional plant-hunters of any native plants, for the sake either of their rarity or of their decorative value.

Second.—That botanists should resort to the assistance of Exchange Clubs, if at all, only for the purpose of obtaining single specimens necessary to fill up blanks in their herbaria, using such assistance with discrimination, and excluding from their operations plants of great rarity.

Third.—That all teachers should inculcate upon their pupils, by precept and example, the lamentable consequences of the wholesale or indiscriminate gathering of plants, especially with their roots or when in seed.

Fourth.—That individual botanists should seriously reflect on these consequences, and abstain from taking more than the smallest number of specimens indispensible for the purposes of genuine study, and even from taking any where the extermination of a particular species from a restricted habitat is threatened.

Fifth.--That tourists and amateurs should be urged to refrain from collecting plants of any degree of scarcity, especially when in flower or seed, it being impossible that ten per cent. of those gathered under such conditions can possibly live after removal.

Finally, the Council earnestly appeals to the editors of all journals devoted to Science and Art as well as to Horticulture and Floriculture and to those of the leading London and provincial papers to assist it in creating a healthy public opinion on this subject by the expression of their sympathy with the effort which the Council is making, and by refusing insertion to advertisements from professional plant hunters.

The Committee hearing that a Society has been formed in Geneva for the preservation of Alpine plants, adopted the following resolution, which was sent to the Secretary, from whom a number of the publications of the Society has been received.

Resolution—"The Committee of the Midland Union of Natural History Societies, deeply regretting the extermination of many of the native plants of Switzerland, desires to express its sympathy with the Société pour la Protection des Plantes, and to pledge the members of its own societies to contribute by all means in their power to the cause of the preservation of the native flora of that glorious land which has been the resort and the delight of so many of themselves and of their countrymen."

Review of Progress.

In conclusion the Council wish to thank the Birmingham Societies for the excellent arrangements which they have made for the comfortable holding of the meeting of the Union; and feel that the second meeting in Birmingham affords an opportunity for looking back to the former meeting there in 1878, and for considering how far each of the component societies has grown since then, and how far they are now fulfilling the objects for which they then entered into association. While regretting that the apathy of the members, to which attention was directed in the last report still exists, the Council think they can see signs of a little improvement, and hope that all who are interested will try to do their utmost to further the progress of the Union. The need of the Union will mainly be felt by active workers—those who are trying to engage in some scientific investigation, in which they feel the necessity of the help and approval of their fellow-workers. To these, when they belong to societies not publishing separate transactions of their own, the "Midland Naturalist" offers a ready means of communication with others, and it would be instructive to have the testimony of those whom the papers and notes in this journal have put *en rapport* with those at a distance who take an interest in the same pursuits. The Council are confident that the number of members who could thus testify to the usefulness of the Union would be no small one. They would invite any, who complain that their wishes are not met by what the Union has hitherto done, to make suggestions and propose improvements; but, at the same time, they would repeat that what is especially wanted, is a more extended and genuine interest in real scientific work, and the attention of the Societies in the Union should be directed to the spreading of this feeling among their members. If this were successfully done, there would at once result a larger attendance at the Annual Meetings, and more valuable contributions to the "Midland Naturalist," and the Union would be able to take the position which was intended by its projectors, as a real Midland Association for the Advancement of Science.

In the discussion on the adoption of the Report and on Mr. Wills's motion several members took part. A suggestion was made that the Union should be made the medium for more intercommunication of lectures and papers among the various Societies composing it. No formal vote was taken on this particular point, but there seemed an agreement that such an arrangement was desirable, and as the programmes for the Autumn Meetings will probably be soon in process of compilation, the Hon. Secretary will be glad to receive the names of gentlemen willing to visit Societies for the purpose of delivering lectures or reading papers if desired. Between Tamworth, Burton, and Birmingham there has already been such interchange to a small extent. In the list of papers read to the Tamworth Society are two by Birmingham gentlemen and one by a representative of the Burton Society, while the Birmingham Natural History Society has had the benefit of a paper from a visitor from Tamworth.

The Honorary Treasurer, Mr. E. de Hamel, then read his report, which showed, with some small arrears yet due, a balance in hand of £3 2s. 11d.

Votes of thanks were then passed to the Officers of the Union, and to the Officers and Members of the Birmingham Societies.

Mr. E. de Hamel was elected Honorary Treasurer, and Mr. T. H. Waller Honorary Secretary for the coming year.

The meeting closed with votes of thanks to the Bailiff and Council of the Mason College for the use of the Examination Hall, and to the Chairman.

THE CONVERSAZIONE.

This, which was also made the Annual Conversazione of the Birmingham Natural History and Microscopical Society, was held in the Town Hall, on Tuesday evening, July 16th.

Undoubtedly the most important part of the display was the large and beautiful collection of British Birds exhibited in the Great Gallery by Mr. R. W. Chase, President of the Society, and also of the Midland Union.

Many of these birds were very rare, including Rose-coloured Pastor, *Pastor roseus ;* Snowy Owl, *Nyctea scandiaca*, from Caithness; Buffon's Skua, *Stercorarius parasiticus*, from Seaham Harbour; and Greenland Falcon, *Hierofalco candicans*, male and female, from Caithness. The most unique exhibits were a splendidly mounted pair of Golden Eagles, *Aquila chrysaëtus*, male and female, from Uig, and a pair of White-tailed Eagles, *Haliaëtus albicilla*, from Lewis. Another noteworthy specimen was a male King Eider Duck, *Somateria spectabilis*, from the Farne Islands, shot this year, and very rare. Among other rare specimens were also a Dartford Warbler, *Melizophilus undatus*, from Kent; an Osprey, *Pandion haliaëtus;* two Goshawks, male and female, *Astur palumbarius ;* Sabine's Gull, *Xema Sabinii* (shot in Warwickshire); a Little Gull, *Larus minutus*, from Shoreham; *Motacilla flava*, and *M. alba*, Blue-headed, Yellow, and White Wagtails, from Brighton; *Sterna Dougalli*, Roseate Tern, from the Farne Islands; and *Hydrochelidon leucoptera*, White-winged Black Tern, from Norfolk. These cases were remarkable also for the fidelity with which they represented the details of the locality in which the birds were obtained. Mr. Chase also exhibited a large number of Eggs and Nests of British Birds, and over forty well-mounted pairs of Horns and Antlers from various parts of the world; also Nests of the Wood or Bush Wasp, and of the Hornet.

The floor of the hall was occupied by a display of about seventy microscopes, under which were exhibited many interesting objects, too numerous, however, to mention. Mr. T. Bolton exhibited an interesting collection of preserved specimens from Naples, illustrating Marine Zoology, and an example of Fish-hatching apparatus; Mr. G. St. John, an Observatory Hive, in which the Bees were seen at work; also Diagrams of the Anatomy of Bees, and their relations to flowering plants.

We can only make a selection from the exhibits in the side galleries. Mr. C. Beale, of Rowley Regis, showed a large number of Palæolithic and Neolithic Implements, including some rare ones in Jasper and Chalcedony, from Torontola, at the base of the Apennines; also some remarkable ancient Pottery, obtained from the old open coal workings at Tipton, Amblecote, and Wednesbury, attributed by the miners to the fairies. Mr. Beale also showed a large number of rare Fossils, from the Carboniferous and Silurian formations, many of them species not yet named. Mr. Horace Pearce, of Stourbridge, Crystals of Copper; Ammonites from the Lias, Whitby; Glacial Clay and Striated Stones; and specimens of erratic Boulders, etc. Mr. S. Price, a number of specimens of India-rubber from India, Java, Africa, &c., in various states of preparation; and foreign Butterflies, Moths, &c. Mr. H. L. Earl, M.A., of Sheffield, two Cases of Butterflies. Prof. T. W. Bridge, preserved specimens of Fishes, from the Mason College Museum. Mr. W. R. Hughes, a small collection of British and Foreign Corals, *Euplectella Aspergillum* (a beautiful sponge from the Philippine Islands), and *Spongia oculifera* (an allied fossil form). Mr. W. J. Harrison, Models used for teaching Physiology; also a number of Slides prepared for the Oxy-hydrogen Lantern to illustrate lectures; some Apparatus for teaching Electricity and Magnetism, devised by himself; and a simple arrangement for Photo-micrography; also Rocks and Fossils from the Coal Measures and Welsh Mountains. Mr. J. E. Mapplebeck, a large and well-arranged collection of living British Ferns, including many rare and novel varieties such as *Lastrea pseudo-mas Mapplebeckii*, and *Athyrium filix-fœmina minutissimum*, both found wild. Mr. W. H.

Wilkinson, set of Lichens from the district and from Scotland, many of which were beautifully in fruit. Mr. W. B. Grove, a small collection of Fungi growing on trees; also some comic sketches of Fungus forays and Portraits. Mr. S. Walliker, living Mosses, Lichens, and Ferns, from Devonshire, and mounted Sea-weeds. Miss France, a plant of Edelweiss, in bloom. Messrs. C. and A. Pumphrey, a very large number of Photographic Slides, prepared for the Oxy-hydrogen Lantern, including instantaneous Landscape Views and Microscopical Objects. Messrs. Alderman White, J. H. Stone, C. R. Robinson, and C. J. Watson, a large number of Landscape and Geological Photographs. Mr. T. J. Baker, four Calorimeters, demonstrating the following thermal facts:—(a) Atomic weights of different metals at the same temperature contain equal quantities of heat; (b) Equal weights of different metals at the same temperature contain unequal amounts of heat; (c) The relative amounts of heat absorbed by dissolving equal weights of different salts in water. Professor J. H. Poynting, Interference of Light by the Biprism. Mr. A. W. Haines, a small Dynamo-electric Machine, with Model Pump attached. Mr. Thomas Clarke, War Medals, obtained in the campaigns in China, Africa, New Zealand, Afghanistan, The Peninsula, &c.

Around the floor was arranged a collection of Diagrams for teaching Physiological Botany, lent by Prof. Hillhouse.

In a separate room Mr. C. Pumphrey exhibited by the Oxy-hydrogen Lantern, at 8 p.m., a series of Photographs of the Yellowstone Park and Niagara taken by himself during his visit to Canada and the United States in 1884; and at 9 p.m., a number of Photo-Micrographs.

The Hall was illuminated by the electric light, and there was a fairly good attendance of visitors and members of the Midland Union, chiefly, however, those residing near Birmingham.

TEACHERS' CONVERSAZIONE.

On Thursday evening, June 18th, the Town Hall was crowded in every corner by the Elementary School Teachers of Birmingham and the immediate neighbourhood, who appeared to derive great pleasure from an inspection of the numerous and attractive exhibits. It was a happy thought on the part of the Birmingham Natural History and Microscopical Society to invite those who are engaged in the work of education in the town to examine the extensive display of natural history specimens, microscopes, &c., which had been got together as part of the eighth annual meeting of the Midland Union of Scientific Societies. About 1,500 invitations were issued, and from the throngs of visitors who filled the building as soon as the doors were opened it would appear that few, if any, of those invited were absent. Mr. Pumphrey's capital lantern lectures on America and on Photo-micrography were listened to with marked attention, and Mr. Chase's magnificent collection of British birds attracted general admiration. Every visitor appeared anxious to make the complete round of the grand exhibition of animate and inanimate objects displayed under the microscopes, and the exclamations of astonishment at the wonders revealed were neither few nor faint. From the general and obvious interest excited it cannot be doubted but that a most pleasant evening was spent by the teachers, and that they would carry away a better knowledge of the attractiveness of scientific pursuits than m ny of them previously possessed. As one connected with the teaching profession of this town, the writer desires, on behalf of his fellow teachers and at the request of many of them, to tender to the Natural History Society their earnest thanks. It crossed the minds of some how great a pleasure it would give to the elder children of our public schools if they, too, could have an opportunity of seeing some of the secrets of Nature, so well revealed! If the Society could see their way to do any such work—and they might well ask the town to help them—it would be sowing seed whose produce could hardly be over-estimated.

EXCURSION TO THE LICKEY HILLS.

The members who had chosen the excursion to the Lickey Hills left Snow Hill Station by the 10 a.m. train, and were joined at Old Hill by a contingent from Stourbridge. Mr. W. J. Harrison, F.G.S., acted as leader, and the party included the Rev. A. Watson, J. Grayston, F.G.S. (Tamworth), J. W. Bodger (Peterborough), Rev. G. St. Clair (Birmingham), Messrs. Marten, Worthington, Madeley, Perry, &c. (Stourbridge), Rev. J. H. Thompson (Cradley), being altogether about twenty in number. On getting out at Rubery Station, the fine section of quartzite, crossed by a well-marked fault, which is exposed in the railway cutting, was first examined. Walking southwards, the junction of the Llandovery sandstone with the quartzite (which is of either Cambrian or Pre-Cambrian age) in the road-cutting nearly opposite the asylum gates was next studied. The sandstone is crowded with casts of *Pentamerus*, &c., but the quartzite is quite unfossiliferous. The brook section in the asylum grounds came next, where the Silurian shales and limestones—resting on the Llandovery—are fairly well exposed. From this point the walk extended along the ridge to Rednal, many fine sections being seen on the way; south of Rednal the quartzite is fairly contorted, being here close to the line of fault which runs along the eastern side of the ridge. At Kendal End the patch of Silurian limestone—long since noted by Murchison—was found, and in the hollow where it lies some good plants delighted the botanists. Nearer to Barnt Green the party walked through the beautiful grounds of Barnt Green House (by kind permission of W. A. Thompson, Esq.), and found the Pre-Cambrian strata (volcanic rocks which *underlie* the quartzite) exposed along the brook course. At this point the party divided, some returning to Stourbridge, while the emainder took the Midland train from Barnt Green to Birmingham. The weather was excellent for walking—fine, but not sunny—and the day proved a very enjoyable one.

EXCURSION TO COVENTRY AND KENILWORTH.

An agreeable party of thirty-four, under the guidance of Mr. J. Levick, travelled in a carriage reserved for them by the L. & N.-W. Ry. Co., from New Street to Coventry, reaching the latter place soon after ten o'clock. Here they were met by Mr. W. G. Fretton, F.S.A., who conducted the party over this interesting city, and whose life-long study of the Archæology of England rendered him eminently qualified for this position. The party visited the site of the Cheylesmore Manor House; Grey Friars Spire, now attached to Christ Church, all that remains of the Franciscan Monastery; Ford's Hospital, the magnificent timber work of which was much admired; St. Michael's Church, with its lofty and graceful steeple, built of red sandstone, and upon which the touches of "Old Father Time" are only too clearly seen in the crumbling of the outer casing of this graceful fabric. St. Mary's Hall was a place of much interest to the party, with its tapestry, pictures, armour, and collection of ancient MSS. They then visited Holy Trinity Church, remains of the Benedictine

Priory and Cathedral, remains of city walls and gates, St. John's Hospital, now the Free Grammar School, where the boys (who were enjoying their luncheon) were evidently as much amused at the curiosity of the party as the party was in viewing their ancient buildings. They next passed Batlake Hospital, and having inspected St. John's Church, they reached the Craven Arms Hotel, where a good luncheon was provided. At one o'clock the party left this historic city with feelings of increased veneration after the interesting survey they had made of its many remains of ancient times. They proceeded by coach and wagonettes along the Warwick Road, with its graceful avenues of oak, to Stoneleigh, where they alighted to view the ancient church. Driving past the Abbey, the magnificent seat of Lord Leigh, they proceeded through the Deer Park and Thickthorne Woods to Kenilworth. Here the services of Mr. Fretton were again most welcome, as he pointed out the various spots of special interest in those picturesque old ruins, recalling the eventful incidents connected with them. After viewing the remains of the Priory and the Parish Church, they reached the station, having spent a very interesting and enjoyable day.

EXCURSION TO CANNOCK CHASE.

This was attended by about sixteen persons, under the guidance of Messrs. J. Brown and W. B. Grove. On descending from the train, which, by the kindness of the L. and N.-W. Ry., was stopped at Anglesea siding for the purpose, the party was conveyed by the Cannock Chase Company's engine to No. 4 Colliery, which most of them descended. On reascending, Mr. W. H. Duignan led them through Court Bank Cover, where they saw the slag of the old iron workings and the oaks which were lopped for fuel. They then walked through Beaudesert Park to Castle Rings, a British fort on Cannock Chase, and saw the foundations of (probably) a Norman castle, which was, at any rate, partly built within the enclosure. After lunch at Hednesford, they returned to Birmingham by 6 15.

SCENES ON THE NORTH COAST OF AFRICA.

BY CLEMENT L. WRAGGE, F.R.G.S., F.R. MET. SOC.

I am now collating the notes and observations of my last voyage to Australia; and some account of the North African coast line may interest my friends in the Midlands.

As the "Maranoa" headed in for the Strait of Gibraltar, I obtained several sketches of Cape Spartel, and of the imposing mountainous ridge at the north-west extremity of the great African continent. Deeply did I admire the grandeur of these noble bluffs. Alternately, however, the coast is bold, low, and undulating; and here the wind action of sub-aerial denudation appears to have been in play. The sun's fierce heat also takes a part and is a substitute for frost in higher latitudes in weathering the rocks—wasted through long ages; and the undulations seem to be débris of a once higher range. After leaving Gibraltar a course was shaped direct for Cape Tennez, Algiers, and Cape Bon; and after passing the former point until we reached the Bight of Tunis, I obtained an almost uninterrupted view of the North African shore. I was charmed beyond measure with the wild, rugged grandeur of this coast line. East from Algiers the picture is unique and of one type. In front are the placid waters of the blue Mediterranean, dotted here and there with rude Arab boats, whose latteen sails bend gracefully to the balmy breeze. Then come shelving hills and undulations reaching up from the coast line, and clad with a scrubby vegetation, while volumes of smoke from charcoal fires may be seen wreathing slowly upwards here and there. Surveying this vista from the distant background towers a noble stretch of weird and grotesque mountain heights, with peaklets, knolls, and tops in almost every conceivable variety of shape and form, indicating a theatre of vast physical changes. A greenish haze hung on this occasion as a filmy veil about the lower parts of the range, while fleecy cloudlets of cumulus floated over the knolls as I had lately beheld them at Ben Nevis. Here again had weathering agencies carved a mountain chain unlike anything I had seen before, and I gazed at its rugged pinnacles with deep fascination.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 83.)

GRAMINA.—*Continued.*

BROMUS.

B. asper, *Murr.* *Rough Brome Grass.*
Native: On hedge banks and in bushy places. Common. July, August. Area general.

B. erectus, *Huds.* *Upright perennial Brome-Grass.*
Native: On roadsides and field borders in calcareous soils. Locally abundant. July.

II. Chesterton Hill! *Y. and B.*; canal bank, Newbold-on-Avon, *R.S.R.*, 1878; Tredington; Honington, *Newb.*; near Edge Hills; Compton Verney; Kineton; near Binton; Wixford; Exhall; Oversley, near the mill; Redhill; bridle Road, Billesley to Wilmcote; Drayton Rough Moors; Great Alne; Rowington; canal bank, near Napton-on-the-Hill.

b. villosus. Rare.

II. Near Chesterton Wood! *H.B.*; near Chadshunt; near Birdingbury Wharf.

B. sterilis, *Linn.* *Barren Brome Grass.*
Native: On banks, roadsides, and in pastures. Rather common. June, July.
I. Sutton Park; Erdington; Middleton; Kingsbury; near Coleshill; lanes about Shustoke; near Arley Wood; near Knowle; Cornel's End, &c.
II. Warwick; Milverton; Kenilworth, *H.B.;* Honington; Tredington; Lambcote, *Newb.;* near Bidford; Oversley; Stratford-on-Avon; Lapworth; Leamington; Southam; Rugby; Newbold-on-Avon.

B. secalinus, *Linn.* *Rye Brome Grass.*
Colonist or casual: In cultivated fields, by roadsides, and on railway banks. Local, but widely spread. July to September.
I. On Dost Hill, near Tamworth, *Ray. Cat.;* near Over Whitacre; Coleshill Heath; Bassett's Green, near Berkswell.
II. Beauchamp's Court, Coughton, *Purt.*, iii., 10; Moreton Morrell, *Y. and B.;* Beavington Waste, near Salford Priors; Oversley, near the wood; Binton; near Stratford-on-Avon; rick yard, Kenilworth; pasture by Newbold-on-Avon.
b. velutinus, Sm. Rare.
II. Near Halford, *Newb.;* in a quarry near Binton Bridges.

B. racemosus, *Linn.* *Racemose Brome Grass.*
Native: In meadows and pastures, rarely by roadsides. Local, but widely spread. June, July.
I. Pasture, near Sheldon Church; Marston Green, in a sandy piece; meadow, near Elmdon; meadow, near Baulk Lane, Berkswell; Holdifast Grange Farm, Erdington.
II. Honington; Tredington, *Newb.;* on the new embankment near Brown's Over, *Blox.*, *N. B. G. S.;* lane near Exhall; Salford Priors; Beavington Waste, near Salford Priors; Binton; Redhill; pastures, near Farnborough; Wawen's Moor, near Wootton Wawen.

B. commutatus, *chrad.* *Confused Brome Grass.*
Native: In pastures, meadows, and by roadsides. Local. June, July.
I. Meadows by Blythe Bridge, Solihull; Earlswood Reservoir.
II. Honington Park; Tredington, *Newb.;* Radway, near Edge Hills; Ashorne, path to Oakley Wood; Binton Bridges; Redhill; Billesley; near Studley Railway Station; roadsides between Brandon and Brinklow.
b. pubescens. Very rare.
II. Roadsides near Redhill.

The three foregoing grasses are often difficult to discriminate; all my specimens, however, have been carefully compared with typical specimens given to me by the late Hewett C. Watson.

Var. *multiflorus*, Parnell.
II. On roadsides and in cultivated fields. Abundant in 1879.

This is a marked variety, midway between *B. commutatus* and *B. mollis*. Prof. Babington considers it to be var. *multiflorus*, of Parnell.

B. mollis, *Linn.* *Soft Brome Grass.*
Native: On banks, roadsides, pastures, and meadows. Very common. June to August. Area general.

The variety *b. glabrescens* occurs frequently with the type, more especially on sandy banks, railway banks, and sandy roadsides.

[*Ceratochloa unioloides*, DC. Mr. Bromwich finds this occasionally near the skin yards at Kenilworth, probably introduced with foreign skins.]

(To be continued.)

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS.

NAME.	DATE 1885.	DATE 1884.	ASPECT. 1885.	SOIL, SITUATION, &c. 1885.
Corylus Avellana ..	Feb. 1	Jan. 13	Open	Hedge. Both male and female flowers.
Tussilago Farfara ..	,, 8	,, 12	S.	Railway bank, same station both years.
Helleborus viridis ..	,, 15	—	Open	Meadow. Inflorescence & foliage only.
Draba verna	,, 21	Feb. 17	,,	Garden path.
Salix capræa	Mar. 8	—	S. E.	Coppice. Female flowers.
Ranunculus Ficaria ..	,, 8	Mar. 6	Open	Coppice.
Primula veris	,, 15	,, 9	,,	,,
Anemone nemorosa ..	,, 15	,, 16	,,	,,
Potentilla Fragariastrum	,, 15	—	,,	,,
Helleborus viridis ..	,, 22	—	,,	Meadow. Expanded flowers, *vide* supra
Adoxa Moschatellina ..	,, 22	—	S.	Bank.
Cardamine hirsuta ..	,, 27	Mar. 6	West	Side of a stream. In fruit.
Caltha palustris ..	,, 27	,, 29	Open	Moist meadow. Same station both years.
Viola Riviniana.. ..	,, 29	—	N. E.	Hedge bank.
Nepeta Glechoma ..	Apr. 3	Mar. 29	S.	Bank.
Petasites vulgaris ..	,, 3	—	Open	Moist meadow.
Viola hirta	,, 11	—	W.	Hedge bank.
Viola Reichenbachiana..	,, 11	—	,,	,,
Anemone Pulsatilla ..	,, 12	—	S. E.	Chalk hills. Mr. J. Catt.
Prunus spinosa	,, 12	Mar. 16	S.	Warm hedge bank. Only a few blossoms
Cardamine pratensis ..	,, 21	Apr. 5	Open	Meadow.
Luzula campestris ..	,, 23	Mar. 30	S.	Luton Hoo Park.
Scilla nutans	,, 25	Apr. 6	S. W.	Coppice.
Ranunculus bulbosus ..	,, 25	—	,,	Railway bank.
Stellaria Holostea ..	,, 26	Mar. 23	S. E.	Warm bank. Comparatively late.
Ranunculus auricomus..	,, 28	Apr. 10	—	Luton Hoo Park. Mr. J. Catt.
Orchis mascula	May 5	May 4	Open	Coppice.
Sisymbrium Alliaria ..	,, 16	Apr. 19	,,	Side of a stream.
Pyrus acerba	,, 17	—	,,	Hedge row.
Cratægus monogyna ..	,, 17	May 11	S.	,,
Geranium Robertianum	,, 28	Apr. 10	S.W.	Hedge bank. Comparatively late.

Staminate Flowers of Mercurialis perennis were gathered as early as the last week of 1884.

J. SAUNDERS, Luton.

METEOROLOGICAL NOTES.—June, 1885.

Atmospheric pressure was unsteady, but not generally low, the mean being 30·050 inches. The highest reading was on the 11th, 30·402 inches; the lowest on the 20th, 29·449 inches. The mean temperature, 58·5°, was slightly below the average. There were some warm days at the beginning and middle of the month. The highest maxima occurred on the 4th, when 83·8° was registered at Loughborough, 82·5° at Strelley, 81·3° at Coston Rectory, 80·9° at Hodsock, and 80·5° at Henley-in-Arden. In the rays of the sun, 134·2° at Loughborough on the 4th, 132·1° at Strelley on the 28th, and 129·3° at Hodsock on the 15th. The lowest minima were 33·5° at Hodsock on the 27th, 34·0° at Coston Rectory, and 37·4° at Loughborough on the 11th, 38·0° at Henley-in-Arden on the 11th and 27th, and 38·5° at Strelley on the 27th. On the grass, 29·2° at Hodsock on the 10th, 31·4° at Strelley on the 27th, and 34·2° at Loughborough on the 11th. The rainfall was above the average, but varied considerably over different districts. At Hodsock the total value was 3·65 inches, at Loughborough and Strelley 3·00 inches, at Henley-in-Arden 2·72 inches, and at Coston Rectory 1·85 inches. The latter station is about twenty miles east from Loughborough, and the difference in the amounts is rather remarkable. The heaviest falls were on the 6th, 7th, and 8th, which contributed above 2 inches of the total. The entire absence of thunder storms is a feature of the month. Sunshine was above the average. Solar halos were observed at Loughborough on the 10th and 11th.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Note.

An Interesting Section, which ought perhaps to be noted, is exposed in a road cutting, over which is carried the Charnwood Forest Railway, at Hugglescote, and near to Bardon Hill. This section—in obtaining which I had the kind assistance of Mr. E. F. Bates—is about 350 feet in length, and is as follows:—Northern drift, rising from 4 feet to 10 feet, containing large blocks of banded slate and volcanic ash, &c., derived from rocks in the immediate vicinity, of various sizes, varying from 29 inches by 18 inches downwards. This rests on, in a conformable manner—so far as exposed, but is very probably thicker—about 5 feet of conglomerate, containing well-rounded and subangular pebbles of banded slate, volcanic ash, quartz and quartzite, millstone grit, carboniferous limestone, fibrous gypsum, chalk and flint, hæmatite ironstone nodules, worn specimens of *Gryphea arcuata*, and small pockets of soft sand. The matrix is a carbonate of lime, which is soon decomposed by weathering, leaving the pebbles rather loose on the surface. This conglomerate is very probably the representative of the gravels of glacial age (Eastern Drift) exposed in other parts of the county, and has been cemented together by the decomposition of the chalk and limestone pebbles it once contained.—H. E. Quilter, Leicester.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, June 30th.—T. H. Waller, Esq., in the chair. The Chairman of the Section accepted, with thanks, on behalf of the society, from Dr. Callaway, D.Sc., F.R.S., two pamphlets, 1. On Comparative Lithology; 2. On the Granite and Schistose Rocks of Northern Donegal. Exhibits:—1. A fine specimen of fossil wood from the Isle of Portland; 2. By Mr. Robinson, a tiger lily, in which several stems had grown together into one flat stem; 3. By Mr. W. H. Wilkinson, a very interesting specimen of an abnormal development of the White Foxglove (*Digitalis purpurea* v. *alba*), in which the terminal flower was formed by the union of 3¼ ordinary blossoms united together, forming a large lily-like bloom of 3in. diameter and 2½in. deep, from a garden at Acocks Green; 4. By Miss Taunton, *Asarum Europæum*, from Ludlow (originally from woods in Herefordshire); 5. By Mr. Bolton, *Argulus coregoni*, found in the canal, near Birmingham (it is a European species, and was found in 1883, in the Royal Aquarium, at Westminster, but its source was not known); 6. By Mr. Udall, Rock specimens from Malvern and Foxyards. SOCIOLOGICAL SECTION, June 25th.—Mr. W. R. Hughes, F.L.S., Chairman, in the chair. Mr. C. H. Allison read and expounded the last two chapters, 13 and 14, of the first volume of Mr. Herbert Spencer's "Principles of Biology," viz., "The Co-operation of the Factors" and "The Convergence of the Evidences," and concluded with a paper on the "Appendix." A discussion followed, joined in by the President, Dr. Hiepe, Mr. F. H. Collins, Miss Naden, and others.—GENERAL MEETING, July 7th. Mr. W. H. Wilkinson exhibited *Orchis maculata*, *O. latifolia*, *O. pyramidalis*, and the cut-leaved mignonette, *Reseda lutea*, from Broadway, Worcestershire.—BIOLOGICAL SECTION, July 14th. The following were exhibited: By Mr. W. H. Wilkinson, a fine collection of plants from Scotland, including *Stellaria nemorosa*, *Cerastium arvense*, *Myrrhis odorata*, and *Equisetum sylvaticum;* by Mr. Thomas Clarke, marine alga, *Callithamnion plumula*, showing fructification; Mr. Thomas Bolton, F.R.M.S., *Lacinularia socialis*, from Warwick; *Euglena*, from Harborne, possibly distinct variety; Mr. J. E. Bagnall, A.L.S., *Scapania irrigua*, from Baddesley Ensor, new to the district; *Anisothecium crispum*, var. *elatum*, new record for Warwickshire, from Sutton; for Mr. Fred. Eneck, *Pyrola minor;* for Mr. John Humphreys, *Acorus Calamus*, Sweet Flag, in fine fruit, from Hewell Grange; for Miss Taunton, *Asarum europæum*, from Herefordshire; for Mr. R. M. Serjeantson, *Asplenium adiantum-nigrum*, *A. Trichomanes*, *Carduus pratensis*, and other plants, from Bampton, North Devon.—SOCIOLOGICAL SECTION, July 2nd. Chapter Seven of Mr. Herbert Spencer's Study of Sociology on "Subjective Difficulties —Emotional," was read by the hon. sec., Mr. A. Browett. On Saturday, the 4th instant, the fifth excursion of the Section was made to the "Country of William Shenstone," under the leadership of Mr. W. Showell Rogers, M.A., LL.M. The party left Mason College at two o'clock, in a four-horse break, and drove first to the Leasowes, the birth-place and almost life-long residence of Shenstone, and where he died. After inspecting the interesting old place and wandering through its shady groves, they proceeded to St. Kenelm's Chapel at the foot of Clent Hills, where Mr. Rogers delivered a short address. They then returned to Belle Vue, Halesowen, at the invitation of E. Gem, Esq., J.P., where they were most hospitably and sumptuously entertained by him. Mr. Rogers then read an able and eloquent paper on "Shenstone's Life and Works." After the customary votes of thanks, and a pleasant stroll in Mr. Gem's grounds, the party returned to Birmingham, bringing to a close, by about nine o'clock, a most successful and agreeable excursion. GENERAL MEETING, July 21st.—Mr. J. Pumphrey exhibited the Lancashire asphodel (*Narthecium ossifragum*), from the English Lakes; also abnormal specimens of the Canterbury bells (*Campanula Medium*), a purple flower with three perfect corollas one inside the other, and a cluster of white blossoms on a much fasciated stem, the corollas variously united, the numbers of the petals varying from 5 to 17 in each altered flower. Mr. A. W. Haines exhibited a proliferous rose. Mr. W. H. Wilkinson exhibited *Potentilla argentea*, from Hagley, rare. Mr. W. P. Marshall (who was heartily welcomed back after his tour in America) gave some interesting accounts of his Natural History researches while in that country, and amongst the many interesting specimens he exhibited were the following:— Stem of verillia, 6½ feet long, from Puget Sound, California, presented by the Californian Academy of Science, as also a copy of their "Proceedings"; Specimen of water, from the Great Salt Lake, Utah; an entomostracon (*Artemisia salina*), from the Great Salt Lake; blind cray fish, from the Mammoth Cave, Kentucky; also a blind insect, allied to the grasshoppers, but not yet known to have been described; swallow-tail butterfly (*Papilio rutulus*), from Yosemite Valley, and from Sierra Madre, California; also a butterfly from Niagara; dragon flies, from the Yosemite and Chicago; and three grasshoppers, from the Great Salt Lake. Also the following plants:—*Plantago officinalis* (?), plantain grass, 3 feet high; *Urtica dioæca* (?), stinging nettle, 8 feet high, stem ¾in. diameter; *Sequoia gigantea*, Californian Big Trees; wood and bark, Mariposa; snow flower, Yosemite Valley Road; cypress, from Montereyl, California; original American cypress; oak galls, &c., with larvæ suspended by threads radially inside gall; *Chlorea vulupina*, lichen, from Big Trees in Mariposa Grove. The whole of his explanations and descriptions were listened to with great attention, and the various specimens were much admired. Mr. Marshall promised to exhibit the remainder of his specimens, including geological ones, at the meeting next Tuesday.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 22nd. The President, Mr. C. Beale, in the chair. Mr. J. W. Neville exhibited specimens of copper and silver ores from Caldera, South America; Mr. Hawkes, the following fungi:—*Puccinia syngenesiarum*, *P. malvacearum*, *Urocystis pompholygodes*, and *Uredo miniata*, the latter an early stage of the Burnet Brand; Mr. Madison, specimen of travertine from the oolite of the Cotswold Hills. Under the microscope, Mr. Tylar showed a section of reconsolidated basalt from the Cakemore Brickworks, Rowley, also teeth of eel. Mr. Hawkes then read a paper on "The Flora of a Country Lane," in which he pointed out the fortunate situation of our great town in a rich and beautiful country, where botanists need never despair of finding abundant fields of labour. The lane selected leads from Minworth Green to Water Orton. The paper, which only dealt with the flowering plants, described the district as one yielding both heath and marsh plants, the latter mostly predominating owing to the lacustrine origin of the district. Lists were given of the more striking botanical features, and the paper concluded by regretting the necessity for the encroachments of the sewage farm. The paper was illustrated by freshly gathered and mounted specimens.—June

29th. Mr. Deakin exhibited the nest and eggs of the golden-crested wren, *Regulus cristatus*, taken near Kingswood; Mr. Madison, specimens of *Paludina vivipara* and its variety *unicolor;* Mr. Hawkes, the following fungi:—*Trichobasis cichoracearum*, *T. rubigo-vera*, and *Ustilago antherarum*, the latter on the anthers of *Lychnis vespertina*. Under the microscope, Mr. Hawkes showed a section of coltsfoot leaf through cluster-cups and spermogones; Mr. J. W. Neville, palate of octopus. —July 6th. Mr. Madison exhibited specimens of *Helix arbustorum*, from near Cheltenham, showing interesting variations; Mr. Hawkes, *Æcidium epilobii* and *Trichobasis caricina;* Mr. Sanderson, a collection of plants from Chapel-le-Dale, including *Primula farinosa*, *Gymnadenia conopsea*, the fragrant orchis, *Paris quadrifolia*, and wood betony infested with *Puccinia betonicæ*. Under the microscope, Mr. Tylar showed a section of iron furnace slag; Mr. Hawkes, a section of leaf of burnet, showing brand *in situ* on uredo spores. Mr. J. W. Neville read a paper on practical microscopy—"Insects' Mouths: how to Dissect and Mount them," which described the various types of insects' mouths and the best manner of dissecting them to show their peculiar features, and the difficulty of dissecting some on account of their smallness. Several objects were dissected, and the process of manipulation shown, through carbolic acid into balsam, and afterwards exhibited.—July 13th. Mr. Hawkes exhibited specimens of the following fungi:—*Uromyces intrusa* and *Aregma obtusatum;* Mr. Insley, specimens of the fossil fruit of a coal plant, and some of the rarer marine shells of the coal period in this district, comprising specimens of lingula, productus, euomphalus, and orthoceras; Mr. Madison, large specimens of *Limnæa auricularia*, from Earlswood. Under the microscope, Mr. Dunn showed a social rotifer, *Lacinularia socialis;* Mr. Hawkes, a section of strawberry leaf through its rust and brand. Mr. Betteridge presented to the Society a second instalment of birds prepared for the cabinet in further illustration of his series of papers on "The Birds of the District;" it consisted of sixteen specimens, mostly summer visitors, and included the wood warbler, *Sylvia sibilatrix;* nightingale, *Philomela luscinia;* and grasshopper warbler, *Salicaria locustella*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. —MONTHLY MEETING, Wednesday, July 15th. Attendance, seven (three ladies). The Chairman reported that at the field day on the previous Wednesday, five members went to Narborough Station, walked along an interesting lane to Enderby, visited the old granite quarry, and returned to Narborough. Search was made at the quarry for several rare plants reported to have been found there in past times, but without success. They are probably extinct. The following objects were exhibited:—By Dr. Cooper, specimens of the grasses *Festuca gigantea*, *elatior* and *loliacea*; by Mr. E. F. Cooper, F.L.S., a growing specimen of *Aspidium lonchitis*, from Scotland, and dried specimens of *Lepidium campestre* and *Smithii*, showing the small differences by which they are distinguished; by the Chairman, a specimen of the Common Bat, *Vespertilio pipistrellus*, and several unusual garden flowers. Mr. W. W. Vincent, of Houghton House, Stonygate, was elected a member of the Section. The Chairman apologised for not being prepared to read the paper announced, on "Mr. John Plant's Catalogue of Leicestershire Mollusca." It required more time than he had expected to put the catalogue into modern form, but he hoped to have it ready for the next meeting.

NIAGARA

AND ITS PHYSICAL AND GEOLOGICAL CONDITIONS.*

BY W. P. MARSHALL, M.I.C.E.

The great Niagara Falls are the most remarkable in the world on account of their enormous volume of water; they are exceeded in height two, three, and more times by other great falls, but far exceed them in the mass of water flowing over the falls. Niagara is the sole outlet of four out of the five great lakes or inland seas that divide the United States from Canada, and form the drainage of the enormous extent of country surrounding them; the largest of these lakes is more than 400 miles in length and 100 miles in width, and the whole together are as large in area as Great Britain.

The Niagara Falls have been known for two centuries, having been first described by a traveller, Father Hennepin, in 1678, who has fortunately left an effective sketch of the appearance of the Falls at that time; and a comparison of this sketch with the present condition of the Falls gives very interesting information about important changes that have taken place during the last two centuries. The Niagara River, in the middle of which the Falls are situated, forms the connection between Lakes Erie and Ontario, and the entire discharge from the four upper lakes, Erie, Huron, Michigan, and Superior, passes through the Niagara River into Lake Ontario, and thence by the River St. Lawrence into the Atlantic Ocean below Quebec. The Niagara River is about thirty miles in length, and falls 330 feet in its whole course, one half of the total fall or 160 feet being in the great Niagara Falls.

The first portion of the river from Lake Erie is divided into two channels, which unite above the Falls in a quiet stream nearly two miles wide; this becomes contracted to three-quarters of a mile in width at the Horse-shoe Rapids immediately above the Falls, where the stream rushes down a steep rocky descent, and falls as much as fifty feet in the length of a mile, before reaching the precipice of 160 feet in height that forms the great cataract of Niagara. The water is very deep at the foot of the cataract, and 180 feet in depth at three quarters of a mile distance; and the force of the falling water is so much absorbed in that great depth

* Transactions of the Birmingham Natural History and Microscopical Society. Read February 24th, 1885.

of water into which it falls, and the velocity of the current is so much reduced, that the disturbance of the surface is but little felt at three-quarters of a mile distance from the foot of the fall, and a small ferry boat is able to cross safely at that point from bank to bank. When in the middle of the stream this ferry boat affords the opportunity of a remarkably grand and comprehensive view of the entire cataract.

The entire width of the water in the cataract is about three-quarters of a mile, but the stream below rapidly narrows to less then a quarter of a mile, and then enters a steep contracted descent, where it falls 100 feet in a distance of seven miles. The greater portion of this fall is in the first two miles, where the stream is narrowed to only 220 feet width, forming the Whirlpool Rapids; the violent rush of the enormous mass of water through this contracted gorge, which is only one-fifteenth of the original width at the edge of the cataract, causes great surface-waves that dash together and throw up spray to a height of twenty and thirty feet. The direction of the stream is then suddenly turned nearly at a right angle, forming a great eddy at the bend, which is the celebrated Whirlpool. During the whole of this seven miles course below the cataract, the stream is confined between steep lofty cliffs 200 feet in height above the water; but these cease suddenly at Queenston, and the remainder of the course is a quiet open stream on to Lake Ontario.

The cataract is divided into two unequal portions by a large island, Goat Island, of about a quarter of a mile in width, and three-quarters of a mile in length, standing between them; the larger cataract is the Horse-shoe or Canadian Fall, which is nearly half a mile width along the curved edge of the fall, and the American Fall on the other side of Goat Island is nearly a quarter of a mile in width. In addition, there is the small Centre Fall, about 70 feet in width, separated by a small rocky island, Luna Island, from the American Fall. The greatest depth of water in the falling stream is in the centre of the great Horse-shoe Fall, and the thickness of the stream at the edge is as much as twenty feet at that part; in the other falls the thickness of the sheet of water is probably from two-thirds to one-third of that amount. A trial of the depth of water over the Horse-shoe Fall was once made by allowing an old ship to be carried over it, which drew eighteen feet of water (the "Michigan" in 1827), and was found to pass over clear.

In these Falls there is an open space forming a cave excavated behind the cataract and extending, probably, the entire length of each fall. This arises from the circumstance that although the upper half of the face of the precipice over which the water falls is composed of hard limestone rock, the lower half is soft shale, which is being continually eaten into and crumbled away by the action of the spray from the cataract; this causes a cave to be excavated that extends to forty feet depth, and gradually undermines the upper rock, which breaks away when unsupported. The cave can be entered at each extremity of the great falls, by passing behind the sheet of falling water; but this can only be done for a short distance on account of the extreme violence of the gusts of wind and spray. In the small centre fall, however, there is the means of passing completely through the cave behind the fall, which is called the "Cave of the Winds," and the visitor, after getting through, returns outside in front of the fall over an accumulation of fallen rocks that have broken away at former times from the face of the rock above. Access is obtained by means of spiral stairs down the face of the rock on Goat Island, and the visitor has to prepare for the purpose by a complete change of clothing to a thick woollen bathing dress with an oilskin overcoat and hood. Goat Island is reached from the shore by a bridge over the stream of the American Fall, crossing a small island that stands in the middle of the stream. On the opposite side of Goat Island there is also a bridge reaching on to the Terrapin Rock, which is in the Horse-shoe Fall, standing on the edge of the fall, and which affords a grand view of the great cataract. At the upper end of Goat Island there are three small islands, "The Three Sisters," connected by bridges, and reaching out one beyond another into the Upper Rapids, of which a striking view is obtained from these islands.

An effective practical illustration of the mass of water in the Niagara Falls may be obtained from the dimensions of the Birmingham Town Hall. Imagine a sheet of water descending in front of the organ and extending in width all across from wall to wall, with a thickness of stream as much as the projection of the side galleries, but the height of the fall nearly three times as great as the height of the hall from floor to ceiling. This will represent the small centre fall, behind which the visitor passes through the "Cave of the Winds," returning in front over the rocks at the foot of the fall, and standing there looking up at the mighty mass of water rushing headlong down close in front. Then imagine this great sheet of falling water extended to a continuous width of nearly half a mile, and increased in thickness to twenty feet, and that will represent the great Horse-shoe Fall.

On the American shore the Cataract House Hotel stands on the edge overlooking the Upper Rapids, and the most satisfactory course for seeing the Niagara Falls is to commence from that point, going direct on to Goat Island and to the Terrapin Rock for a close sight of the Horse-shoe Fall, and on to Luna Island for the American Fall, and to the "Three Sisters Islands" for the Horse-shoe Rapids; then descend the stairs to go through the "Cave of the Winds." Next see the other side of the American Fall from the shore, descend to see the fall from the rocks at the bottom, and cross over by the ferry, getting the view of both falls from the middle of the river; then see the Horse-shoe Fall from the Canadian side, and the view of the whole from the Suspension Bridge which crosses the river at a quarter-of-a-mile below the American Fall. The general views of the whole Falls are better appreciated after having had the opportunity of seeing the cataract from a close point of view, both at the top and from below, in order to realise the enormous magnitude of the mass of falling water; the sense of which is dwarfed in effect when seen first as a whole from a distance, on account of the very great width (nearly three-quarters of a mile) over which the Falls extend. The enormous mass of spray that is thrown up by the cataract forms a remarkably striking feature, floating in front of the Falls like a gauze veil that is continually changing in form and position; and in the case of the great Horse-shoe Fall this cloud of spray rises up in the air sometimes to three times the height of the Falls. The rainbows that are so numerous and brilliant in the spray make a lovely picture.

In consequence of the continued wearing away of the shale strata behind the cataract, and the breaking down of the overhanging limestone rock, the whole face line of the Falls is subjected to a gradual displacement, shifting it backwards up the stream with a certain, though very slow, movement; and the result has been a definite change in the position of the cataract during the time it has been known, and even within the memory of present visitors (in 1850) a large mass of rock at the outer extremity of the Horse-shoe Fall has broken away and fallen to the bottom of the cliff. This mass, called the "Table Rock," was completely undermined, and projecting over the stream below the Falls, standing out in front of the cataract and affording a very fine point of view; it fell suddenly, without previous warning, and a man upon it at the moment had only just time to escape. It appears from Hennepin's sketch, made two centuries ago, that at that time this Table Rock formed an island at the edge of the cataract, like the Terrapin Rock at the present time at the other extremity of the same fall, and a portion of the stream passed behind the island and formed a separate small fall at right angles to the main Falls. It is known also that at the present time the centre portion of the Horse-shoe Fall has become more deeply indented than formerly, modifying the previous horse-shoe form that originated the name of the fall.

On considering the whole circumstances, the conclusion seems irresistible that the Horse-shoe Fall has gradually cut its way all across the front of Goat Island from the end of the American Fall to its present position, and that the American Fall has not materially changed during that time, except in getting partially indented in the centre and somewhat horse-shoe in form, from the same cause that has given its form to the Horse-shoe Fall, namely the greater depth and force of current in the middle of the stream than at the sides. Further, the conclusion seems irresistible that the same cutting away action had previously carried the Horse-shoe Fall all across the face of the present American Fall, forming in its course the precipice over which that now falls; and that in still earlier times the Horse-shoe Fall had similarly cut its way all through the seven miles of the present gorge from the face of the cliffs at Queenston, where the cataract must have commenced. The progress during the last two centuries is estimated at about a foot per year; but as regards the future progress of Niagara, it has to be noticed that when the Falls have receded another mile, they will have reached the open space behind Goat Island, and at a second mile distance the river is nearly two miles wide, so that the fall will be then three times the total width of the present Falls, and the thickness of the sheet of water proportionately less. The consequence of this will be a proportionate reduction in the wearing action of the water, and in the rate of the receding of the fall. This rate will be also further reduced by the circumstance that as the chief breaking down force in action in cutting back the present Falls arises from the perishing of the supporting shale under the top limestone rock, causing this rock to be undermined and break off in masses, and these strata are not horizontal but dip backwards, at an inclination of about twenty-five feet per mile, when a distance of about three miles back has been reached, this cause will have ceased from the cropping out of the strata.

Some other circumstances will thus intervene to affect the result, complicating the question and making it a very interesting one for consideration. The height of fall of the cataract will be increased by the addition of the fifty feet that the stream now falls in passing the upper rapids. The excavation of the new receding channel may not extend across the entire two miles width of the river, and may probably be limited to a central portion of greatest depth and force of current; in that case the American Fall on the opposite side of Goat Island from the new excavated channel may be expected to be run dry, and to show only a bare precipice in place of the present cataract, and the "Cave of the Winds," though still a cave, would lose both its water and winds. When the cataract recedes still further to the point where the stream divides into two channels it will depend upon the force of current and the nature of the bottom in each whether the cataract recedes along both streams equally or not.

The volume of water that is constantly rushing over the Niagara Falls has been estimated at about a million cubic feet per second, or about six million gallons per second. An idea of this quantity of water can be formed from the size of the Birmingham Town Hall; imagine the interior of the hall entirely cleared from galleries and orchestra, leaving the bare external walls, then this quantity of water would fill it from floor to ceiling twice over every second. Some idea of the probable correctness of the estimated discharge of a million cubic feet per second may be readily formed from the following general dimensions:—2100 feet width for the Horse-shoe Fall, 1100 feet width for the American Fall, and 70 feet for the Centre Fall; and then taking twenty feet for the thickness of the stream of water at the Horse-shoe Fall, and assuming two-thirds that depth at the American Fall, and one-third at the Centre Fall, a total sectional area of about 60,000 square feet is obtained for the stream of water at the edge of the Falls; then this area of stream with a velocity taken at twelve miles an hour, or eighteen feet per second, gives a discharge of about a million cubic feet per second. At the ferry below the foot of the Falls, where the depth of water is 180 feet, and the width about a quarter of a mile, the same quantity of water per second gives a current running at only about two and a half miles an hour, and slow enough to allow of being crossed by a small rowing boat.

In an interesting paper on Niagara Falls which was given at the recent Montreal Meeting of the British Association, it was pointed out that the peculiar conditions that are present there, namely a hard stratum forming the upper part of the precipice over which the cataract falls, with a soft stratum forming the lower portion that is continually being caved out, leaving the projecting hard rock at the top, is really the essential condition requisite for the formation of all *cataracts;* and when the face of the precipice is uniform in hardness from top to bottom the inevitable result of wear is a gradual uniform slope forming a *rapid* and not a *cataract.* The hard rock stratum of Niagara Falls crops out upon the face of the Queenston Cliff, where it is twenty-five feet in thickness and 250 feet in height from the water; and it follows that in the origin of these Falls they were nearly 100 feet greater in total height than at the present time, and had the same cataract form in the upper portion, but probably the form of a rapid in the lower portion on account of the soft stratum not extending completely to the bottom; also that in the future of these Falls the present cataract character will ultimately become lost, and the whole be reduced to a rapid.

THE FIRST DISCOVERY OF THE CHOLERA BACILLUS.*

BY FRANCIS FOWKE, F.R.M.S.

During the outbreak of cholera, in 1849, a sub-committee of the Bristol Medico-Chirurgical Society was appointed to investigate the nature of cholera by means of microscopical observations. Two of the sub-committee, Drs. Brittan and Swayne, each separately examined the rice water evacuations, which had been obtained from two patients in the cholera hospital, with microscopical objectives of $^1/_8{}^{th}$ and $^1/_{12}{}^{th}$, by Powell and Lealand, and Ross, respectively, and they describe as follows, the cells, annular bodies, or corpuscles, which they observed:—"They vary very much in size and apparent structure during the different stages of their development. The smallest are of the same size as, or even much less than, blood-globules, so that to show them properly an object-glass of high magnifying power, such as one-eighth, one-twelfth, or one-sixteenth of an inch is required; their walls refract light powerfully; fragments of them present the appearance of *small segments of circles.*" The italics are mine. Dr. Budd found identical bodies in drinking water, obtained from cholera districts, and Dr. Brittan also from the air of infected places.

* Abstract of paper read before the Birmingham Natural History and Microscopical Society, May 19th, 1885.

Dr. Koch thus describes the cholera bacillus in his reports on the cause of the cholera-epidemic, presented to the German Government, as the result of investigations on the excreta, and on the dead bodies themselves, of cholera patients in Egypt and in India. The internal organs, lungs, liver, spleen, kidneys, etc., as well as the ejecta, were found to swarm with microbia of a great variety of kinds; in all cases was found one definite kind of bacillus. This was found in largest quantities in the tubular glands of the intestines, especially between the epithelium and the membrane of the gland. This particular form was also never found in the intestines or in the ejecta of those not suffering from cholera.

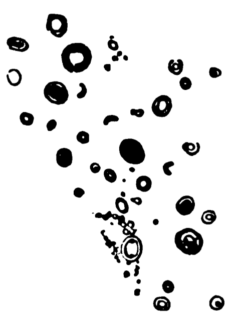
The cholera bacillus is not quite straight, but is somewhat curved, in the manner of a comma, or even nearly semicircular. In cultivation, there often arise S-shaped figures, and shorter or longer slightly wavy lines.

As to the question whether their presence is simply due to the presence of the choleraic disease, which promotes their growth and development, or whether they are themselves the cause of cholera, Dr. Koch is very strongly of opinion that the latter is the true explanation, since they are never found either in the organs or the ejecta except in the case of patients who have died of, or are suffering from, cholera. They are also found in that organ which is the seat of the disease, namely, the intestines; in the first feculent ejecta, the bacilli occur only in small quantities, while in the liquid odourless ejecta they occur in enormous quantities, all other kinds of bacteria being almost entirely absent; they diminish in number as the excreta become more feculent, and have entirely disappeared when the patient is completely restored to health.

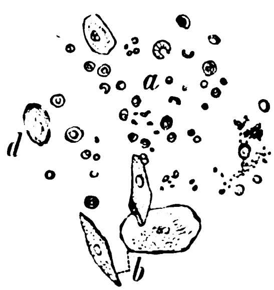
If this description is compared with that of Drs. Brittan and Swayne, who examined upwards of sixty cases, there is a remarkable resemblance. Dr. Brittan found some peculiar corpuscles to be constant in the intestinal discharges of cholera patients; and similar bodies, but smaller, though well defined, were discovered by him in the matters vomited; they appeared larger and more compound in the dejections; decreased as the disease progressed favourably; and vanished with the disappearance of the symptoms. Dr. Brittan afterwards examined, under the microscope, specimens of healthy fæcal matter, and the fluid stools of typhus, typhoid, and other diseases; but failed to detect anything corresponding with the peculiar corpuscles belonging to cholera dejections, though he discovered these bodies in cases of severe choleraic diarrhœa. From these observations, he inferred that the bodies in question were peculiar to cholera, and bore some essential relation to the disease.

For comparison are appended some of the figures by Drs. Brittan and Swayne, and others which have been very kindly lent me by Dr. Klein, which illustrate the chapters on cholera in the new edition of his work on "Micro-organisms." It is Dr. Klein's * view that the bacillus forms rings and splits off, forming the cholera bacillus of Koch, which is also known as the "Comma Bacillus," and is a segment of a circle, as described by Drs. Brittan and Swayne. After carefully comparing the evidence of the description and the woodcuts, I venture to claim for Drs. Brittan and Swayne the priority of the discovery of the cholera bacillus. Then, as now, the discovery received great opposition, a sub-committee of the College of Physicians was appointed, who reported against it, but with insufficient evidence to overthrow the demonstrations.

My reasons for bringing forward this page of forgotten history in the study of the disease of cholera, is not only the interest attached to the way in which the question of the fungoid character of the disease was medically and publicly discussed in 1849, but principally to show, as far as can be now ascertained from the above report, that the comma-bacillus was known and recognised so far back as thirty-five years since, the discovery being made by two Englishmen, Drs. Brittan and Swayne.

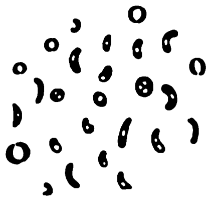


Drs. Brittan and Swayne's illustrations of cholera bodies from vomited matter, showing rings. Magnification not stated, but drawn under Powell and Lealand, $^{1}/_{12}$th objective.



Cholera-cells in vomited matter, from Case 5 (first series). *a*, Cholera-cells; *b*, Squamous and columnar epithelium; *c*, Round, clear, oily globules; *d*, Starch-grain. Magnified 420 diameters. Dr. Swayne.

* See also Dr. Watson Cheyne, *Brit. Med. Journal*, No. 1270, May 2nd, 1885, page 878, fig. 6.



Dr. Klein's illustration, showing rings. Magnified about 700 diameters.

Dr. Klein.

Dr. Swayne.

For further details see *British Medical Journal* of March 21st, page 589.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 213.)

Description of Beds in the "Spinatus" Zone.

I have found it more difficult to correlate the beds of the "*Spinatus*" *Zone* than those of the "*Margaritatus*," because there are very few sections in which the beds just below the rock-bed can be seen, and these few are long distances apart. It is possible that the rock-bed ("B") is the sole representative of the "*Spinatus*" *Zone* in one or two places.

Bed "E."

This bed has been placed as the lowest of the "*Spinatus*" *Zone*, not so much for the fossils it contains as for those it does not. It appears to be a marly, micaceous clay, very sandy in some places, and containing concretionary ferruginous nodules, which latter, like the bed itself, are rather unfossiliferous. The thickness at Byfield is 2ft. 7in.; but what I regard as the same bed is about 7ft. or more at Badby, and more than 13ft. at Watford. Exposures of the bed are uncommon, and fossils seem rare, so that I can give no useful list.

Bed "D."

This is a ferruginous, sandy limestone, very shaly at Byfield and Watford, more compact at Badby and near Northampton, but in all these places abounding in fossils. It is only 4in. thick at Byfield, but is 2ft. 3in. at Watford, and 3ft. to 4ft. at Badby. I believe this bed in several places immediately underlies the rock-bed, forming with it only one mass of stone, the usual intervening bed of clay being absent.

Fossils:

Ammonites margaritatus (rare)	Watford, Milton.
Belemnites paxillosus	Watford.
Belemnites	Watford, Badby, Milton.
Cryptænia consobrina	Badby.
Pleurotomaria heliciformis	Watford.
Ostrea cymbium (abundant)	Badby, Watford, Byfield.
Ostrea sportella	Watford.
Pecten liasinus (abundant)	Byfield, Badby, Watford, Milton.
Pecten textorius	Badby.
Pecten æquivalvis	Watford, Badby.
Limea acuticosta	Byfield, Watford, Milton.
Leda (*sp.* ?)	Milton.
Astarte striato-sulcata	Badby.
Protocardium truncatum (abundant)	Byfield, Badby, Watford, Milton.
Cardinia antiqua	Badby, Watford, Milton.
Tancredia (*sp.* ?)	Watford.
Pholadomya ambigua	Badby.
Pleuromya costata	Badby.
Terebratula punctata	Badby, Milton.
Rhynchonella tetrahedra	Badby.
Pentacrinus (*sp.* ?)	Badby.
Cidaris (spine)	Milton.
Serpulæ	Watford.

Bed "C."

It is even more uncommon to find this bed exposed than "E," and I cannot point to a single place in the county where it can be now seen. There was a pretty good section of it near to Byfield, when the East and West Junction Railway was being made, and Mr. E. A. Walford, F.G.S., has described it* as a marly clay, containing concretionary ferruginous nodules, having a thickness of 1ft. 6in. No doubt this and two or three of the lower beds are what can be seen at Market Harboro', near to the railway station.

Bed "B."

The Rock-Bed.

This is undoubtedly the most important bed of the Middle Lias. Its usual character is that of a hard, calcareous, and ferruginous rock, varying in colour from a bluish green to a reddish brown, according to the amount of weathering it has experienced. The change in colour is due to a change in the condition of the iron present in it. The rock is often sufficiently hard and compact to form a good building stone, and many villages have been built of it, but of late it has been almost entirely superseded by bricks for such purposes; in like manner it has been replaced by slag and Hartshill stone for public road-making, though it is still used at times for private roads and sometimes of course for building.

The rock is also at times sufficiently ferruginous to be worked as an ironstone, the calcareous matter present being considered an advantage by acting as a flux.

It is sometimes so sandy that it can scarcely be distinguished from the Northampton sand by its mineralogical characters only; this is the case around Byfield. Fossils are exceedingly abundant, and it is common to find bands made up almost entirely of *ossicles and fragments of shells*, or of shells of *Rhynchonellæ*, or less commonly of *Terebratulæ*. Usually the fossils contain beautifully crystallized calcspar, though where the bed is very sandy the fossils are only casts. *Large Belemnites* are common, and serve to distinguish it from the Northampton sand, in which few are found.

In the lower part of the bed flattened nodules or concretions of argillaceous limestone are at times met with; they are rather abundant at Bugbrook.

* "On some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford.

The rock-bed is the great water-bearing bed of the county to the West and South-west of Northampton, and there are probably some hundreds of springs and wells in it used for domestic purposes. The making of wells has facilitated the examination of the rock in districts where it does not come to the surface. As I propose to devote a section entirely to the consideration of the water-bearing capabilities of this bed, it is not necessary for me to do more here than call attention to the remarkable uniformity of this characteristic of it.

The thickness of the rock-bed varies very little, comparatively, in the west and south-western parts of the county; in most cases it is between 5 and 6 feet, but near Byfield about 11 feet. In the northern parts of the county it gets very thin, and may be absent altogether in some places.

Sections of the rock-bed are numerous, so I have omitted giving the localities of the fossils. A more complete list of the fossils, too, will appear in the section dealing with the Palæontology of the Middle Lias.

Fossils.

Ammonites spinatus.
Ammonites Holandrei.
Belemnites paxillosus, and others.
Cryptænia consobrina.
Eucyclus concinnus.
Pleurotomaria sp. (?)
Actæonina Ilminsterensis.
Ostrea submargaritacea.
Ostrea sportella.
Ostrea cymbium.
Plicatula spinosa.
Pecten æquivalvis.
Pecten liasinus.
Pecten dentatus.
Pecten textorius.
Hinnites Davæi.
Lima punctata.
Lima Hermanni.
Macrodon liasinus.
Astarte striato-sulcata.
Cardinia concinna.
Spiriferina oxygona.
Terebratula punctata.
Terebratula Edwardsi.
Waldheimia indentata.
Waldheimia resupinata.
Rhynchonella tetrahedra.
Rhynchonella tetrahedra, var. *Northamptonensis.*
Serpulæ.
Pentacrinus.

Bed "A."

The Transition Bed.

This bed in Northamptonshire is usually a rather thin band of gray, friable, sandy marl, passing upwards into a red sandy clay. The lower part only is fossiliferous, but that extremely so, though most of the fossils are small. The marl appears to be made up chiefly of rounded calcareous grains; it effervesces considerably with acids, and weathers reddish-brown on exposure. This lower portion sometimes passes into a hard and compact limestone, but even then, apart from the fossils it contains, it is easily identified.

The thickness of the bed seldom exceeds six inches, but near to Northampton it reaches fourteen inches.

Considering the thinness of the bed, the number of distinct genera and species of fossils is very large. The characteristic ammonite, *A. acutus* (Tate), is nearly everywhere abundant, and *gasteropods* must have swarmed in the shallow sea in which it was deposited. Most of the fossils of the "*Spinatus*" *Zone* are found in this bed, hence it is usually included in the Middle Lias. *Rhynchonellæ*, *Ammonites*, and *Belemnites* are common, but they are all small, as though the conditions were unsuitable to their proper development. *Serpulæ* are rather abundant, and of large size.

The list of fossils given below is by no means a complete one, but only a list of such as can be found in most places, where the bed is developed, and since these places are rather numerous I have omitted giving the localities from which the fossils have been obtained, as in the case of the rock-bed.

FOSSILS:—

Ammonites acutus.
Ammonites Holandrei.
Belemnites.
Cerithium ferreum.
Cerithium liassicum.
Chemnitzia foveolata.
Chemnitzia semitecta.
Eucyclus Gaudryanus.
Phasianella turbinata.
Turbo linctus.
Trochus lineatus.
Cryptænia consobrina.
Cryptænia expansa.
Actæonina Ilminsterensis.
Pecten textorius.
Pecten æquivalvis.
Pecten liasinus.
Cucullæa Münsteri.
Astarte Voltzii.
Astarte striato-sulcata.
Cardinia philea.
Ceromya (Venus) bombax.
Rhynchonella tetrahedra.
Rhynchonella tetrahedra, var. *Northamptonensis.*
Ditrypa etalensis.
Ditrypa circinata.

CONDITIONS OF DEPOSIT OF THE MIDDLE LIAS.

That the various members of the Lias—Lower, Middle, and Upper—are conformable one with the other is generally admitted; there is no great break in the succession of life at any part of the series, although considerable changes occur in the nature of the sediment.

From the lithological characters of the part of the Lias we have been considering *(ferruginous limestones and sandy clays containing concretionary ferruginous nodules)* as well as from the fossil contents of the upper beds, I think there was a shallowing of the seas taking place in this district from actual elevation of the sea-bed. The sandy nature of the beds, the large amount of iron often found in the rock-bed, and the common occurrence of wood in the same, may, I think, be taken as indications of nearer, and, therefore, recently formed land. This gradual elevation continued probably till some part of the rock-bed protruded from the water, and suffered the erosion which it exhibits in a few places; other portions meanwhile remained still under water, and received the shallow water deposits which we have called the Transition Bed.

Professor Judd ("Geology of Rutland," p. 65) observes that "When the junction of the Upper Lias with the Marlstone Rock-bed is seen, the latter often presents the appearance of having suffered erosion before the deposition of the latter;" and also "Taking into account all the characters presented by the Marlstone Rock-bed, and remembering the evidence of shallow water conditions which the beds immediately lying upon it exhibit, it seems probable that an interval occurred between the deposition of the Marlstone and the Upper Lias; but when we remember the fact of the passage of certain species from one to the other, especially of the Planulate Ammonites, it is clear this interval was not one of long duration."

Mr. E. A. Walford, F.G.S. ("On some Middle and Upper Lias Beds in the neighbourhood of Banbury") says:—"The shelly band at the top of the rock-bed, at Aston-le-Wall in particular, is made up chiefly of broken and rolled Belemnites, separated valves of Rhynchonellas, and detached Pentacrinite joints, suggesting an interval of cessation in deposition of sedimentary matter prior to the formation of the next layer. One fragment I have of the rock-bed shows an eroded surface in the hollows of which are numbers of valves of *Astarte striato-sulcata* (Romer), for the most part in an upright position, and so packed as to suggest the necessity of a strong current to place them so. The Transition Bed generally at Aston presents evidences of littoral conditions in the worn and fragmentary character of many of the shells."

It is probable that the shallow sea in which the Transition Bed was deposited was not entirely cut off from the deeper sea in which the Upper Lias was developing, because distinctly Upper Lias fossils are found mixed with Middle Lias ones in this bed, though there is a great preponderance of the latter.

(To be continued.)

ON STARCH.*

BY EDWARD FRANCIS, F.C.S.

The substance of plants is not homogeneous, but is composed of small structures termed cells. Each cell is a whole complete in itself, at least for a time, and is composed of solid, soft, and fluid layers. The formative material which closely lines the walls of the cells, and which is soft and inelastic, was termed by Mohl, in 1846, protoplasm. It is an albuminous matter, and consists of protein compounds, fat, mineral salts, and water. It dissolves in dilute caustic potash, from which solution casein may be separated by acetic acid. This substance is analogous to the fibrin of animals and the gluten of vegetables. The cell wall consists of cellulose, one of the many hydro-carbons. The protoplasm encloses cavities which are filled with a watery fluid termed cell-sap. In all the cells of the higher plants the protoplasm encloses a rounded body, the substance of which is similar to that of the protoplasm itself. This body is the nucleus. By the formation of grains of chlorophyll the protoplasm becomes differentiated into a colourless, homogeneous part, and into smaller distinct green portions imbedded in the former, the grains of chlorophyll. This differentiation may take place in the dark, when yellow grains only are produced; but, on the contrary, the chemical process by which the green colour is produced has a complicated dependence on light. The yellow and orange rays cause the greatest amount of assimilation, and the violet and indigo least.

The assimilation of plants depends upon the decomposition of carbon di-oxide by the chlorophyll of the cells, which process is rendered perceptible by the exhalation of oxygen in volume nearly equal to that of the carbon di-oxide absorbed. The yellow chlorophyll grains formed in the dark are small, but become considerably longer and green on exposure to light. It is only after they have assimed this green colour and under the continued action of light that they form starch, which becomes imbedded in the chlorophyll grains. This change may be represented by the equation—

$$6CO_2 + 5H_2O = C_6H_{10}O_5 + 6O_2.$$

From which it is seen that twelve volumes of carbon dioxide produce twelve of free oxygen gas. When cells whose

* Read before the Nottingham Naturalists' Society, February 3rd, 1885.

chlorophyll has produced starch under the influence of light are again placed in the dark, the starch is absorbed and disappears completely from the chlorophyll grains. From these facts it appears that the formation of starch is a function of chlorophyll exposed to light, and its disappearance a function of chlorophyll not exposed to light. Kraus found that in plants of Spirogyra which had lost starch after exposure to dark, the formation of that substance in the chlorophyll grains recommenced in five minutes in direct sunlight, and in two hours in diffused daylight.

Starch always appears in an organised form as solid grains having a concentrically stratified structure, which arise at first as minute masses in the protoplasm, and continue to grow while lying on it; their growth stops when they cease to be in contact with the protoplasm and when they have reached the cell-sap. Every grain of starch consists of a hydro-carbon, water, and a small quantity of mineral matter (ash). The hydro-carbon has the same percentage composition as cellulose, to which it bears a strong resemblance. The starch, however, occurs in two forms in each grain: one easily soluble, which yields a fine blue with free iodine in solution (granulose), and the other, which in its composition resembles the cell wall substance (starch-cellulose). These occur together at every point of the grain; if the granulose is extracted the cellulose remains as a skeleton, which shows the structure of the grain, its total weight being only two to six per cent of the whole. Since granulose preponderates, iodine solution colours the whole blue. Starch grains have always more or less rounded forms, and their internal organisation has reference to a centre of formation lying within themselves. The young grains appear to be always spherical, but since their growth is scarcely ever regular, their form changes to ovoid, ovate, rounded polyhedral, &c. Careful microscopical examination shows that each grain has water distributed throughout its organisation; every point contains water as well as cellulose and granulose. Usually the amount of water increases from without inwardly, and attains a maximum at a fixed point. The cohesion and density decrease with the increase of water, as also the index of refraction, on which partly depends the power of perceiving these properties. The outermost and least watery layer is succeeded by a sharply defined watery layer, and so on until the nucleus is reached, which is a very watery part surrounded by a less watery one. Although every layer is disposed around this centre, yet they are not continuously developed around the whole nucleus.

In small spherical grains this is the case, but when the number of layers increases with growth, they increase in width more rapidly in the direction of the axis of the grain. The growth of starch grains is accomplished exclusively by intussusception, new particles being thrust in between the layers already existing both radially and tangentially, the proportion of water at the particular places being at the same time changed.

Classification of Starches.

The examination of starches by the microscope requires practical study; drawings and descriptions must be used as guides merely. It is not easy to preserve starches mounted as microscopical objects. Glycerine is the best medium. A high magnifying power is not generally required, except for such as rice and pepper. The best powers are $\frac{1}{2}$, $\frac{4}{10}$, and $\frac{1}{4}$, with micrometer eye-piece. The value of the micrometer scale must be of course ascertained by comparing the divisions with those of a stage micrometer graduated in hundredths and thousandths of an inch. In illuminating the object oblique light is best, when the rings are best seen. The polariscope is very useful, as many starches yield black crosses, which are characteristic, *e.g.*, potato. Dr. Muter has arranged the starches in five classes, according to the following characters:—

Class I.—The hilum and concentric rings clearly visible; all the starches oval or ovate. This group includes tous les mois, potato, arrowroot, calumba, orris, galangal, and turmeric.

(1.) Tous les mois or Canna arrowroot. The granules vary from ·0037 to ·00185 inch. In shape they are ovoid when small. The largest are oval, with pointed ends. Hilum annular eccentric; rings incomplete, very fine, narrow; with polarised light the cross is more regular than that of potato starch.

(2.) Arrowroot (Jamaica) from *Maranta arundinacea* granules ovoid, flattened, tending to triangular form in larger and round in smaller, rings visible and numerous, not very marked; size, ·00138 inch.

(3.) Potato (*Solanum tuberosum*). Granules vary in shape and size, some small and circular, others large, ovate, and oyster shaped. Hilum annular, and rings incomplete. In large grains, rings numerous and distinct. Size, ·0027 to ·00148 inch. Eccentricity averages $\frac{1}{8}$.

Class II.—The concentric rings all but invisible; hilum more or less stellate. To this group belong the starches of bean, pea, maize, lentil, dari, and nutmeg. The nucleus of the Leguminosæ is seen usually as a long, more or less stellate, air-filled black hollow. The rings are rendered visible by treatment with chromic acid. The starches from bean, pea, and lentil are in shape oval, oblong, and almost identical; but pea and bean have stellate hilum, whilst lentil has a long depression. The size of bean starch is ·00135 inch, of pea ·00111 to ·00007 inch, and lentil ·00111 inch.

The starch of maize varies in form, round to polyhedral, and the size is ·00074 inch.

Class III.—Starches having both the concentric rings and hilum invisible in most granules. This important class includes wheat, barley, rye, chestnut, acorn, and a variety derived from medicinal plants, jalap, rhubarb, senega, &c. Wheat starch is extremely variable in size, having from ·00185 to ·00009 inch. The granules are circular, or nearly so, and flattened. Polarised light shows a cross but not well with water as a medium.

Barley granules are fairly uniform in size, ·00073 in., and in form are slightly angular circles. Acorn granules ·00074 in. diameter, and almost round; eccentricity $\frac{1}{4}$. The others call for no special remark, and are distinguished chiefly by measurement.

Class IV.—All the granules truncated at one end. This class includes sago, tapioca, and arum, besides several drugs, viz.:—belladonna, colchicum, scammony, podophyllum, canella, aconite, cassia. Sago starch is found in oval ovate granules, and ·0026 to ·00111 in. in size. There is a curved hilum at the convex end and rings are faint. Tapioca being prepared on hot plates has the starch grains altered from their original shape. They appear in groups of two to eight granules each, showing a little circle with a broad flat zone around it. In form they vary from that of a kettle-drum to a sugar loaf, a conical hollow appearing in the nucleus. Size, ·00074 to ·00055 in. Each granule is truncated in one facet. Arum starch has two facets. The starches from the medicinal plants are similar, but are best distinguished by their measurements.

Class V.—In this class all the granules are angular in form. It includes oats, tacca, rice, and pepper, as well as ipecacuanha. Oat starch is mostly polyhedral, being irregularly three to six-sided and ·00037 in. in size. Rice starch has a starred hilum, visible under a power of $\frac{1}{8}$ to $\frac{1}{12}$

objective. Measurements, ·0003 to ·0002 inch. Pepper starch is only distinguished from that of rice by its smaller size and uniformity of granule.

Chemistry of Starch.

Starch, chemically speaking, belongs to the carbo-hydrates, sub-class amyloses, and contains carbon, combined with H and O, in the proportion to form water. The carbo-hydrates are divided into three classes—

	Glucoses.	Saccharoses.	Amyloses.
Composition	$C_6 H_{12} O_6$	$C_{12} H_{22} O_{11}$	$C_6 H_{10} O_5$
or	$C_{12} (H_2 O)_{12}$	$C_{12} (H_2 O)_{11}$	$C_{12} (H_2 O)_{10}$
	Grape Sugar (dextrose), Fruit Sugar	Cane Sugar (saccharose), Milk Sugar (lactose)	Starch, Dextrin, Inulin, Cellulose, Gum.

The close connection between starch and the sugars is seen from the above table, and will readily explain how starch is converted by absorption of one molecule of water to form cane sugar and two molecules to form glucose in plants. Glucose readily loses water to re-form starch, which becomes stored up in the plant as reserve material; when starch is acted upon by dilute mineral acids, chloride of zinc, and by certain ferments, diastase, saliva, yeast, &c., it is changed into sugar. In these reactions starch takes up the elements of water, and is resolved into glucose and dextrin.

$$H_2O + 3\,C_6H_{10}O_5 = \underbrace{C_6H_{12}O_6}_{\text{Glucose.}} + \underbrace{2\,C_6H_{10}O_5}_{\text{Dextrin.}}$$

Hence, glucose, when required in considerable quantity, is always prepared from starch. When starch is heated with water near to boiling point, the granules burst and disappear, producing a thick gelatinous mass, slightly opalescent from the shreds of fine membrane—the starch cellulose of the granules. By the addition of large quantities of water the solution may be made to pass through filter paper. It is doubtful whether the starch is really soluble—it is more likely to be merely suspended in a swollen, transparent, insoluble jelly. Again, when gelatinous starch is boiled with a small quantity of hydrochloric, sulphuric, or indeed any acid, it speedily loses its consistency and becomes thin and limpid from having suffered conversion into a soluble gum-like substance called dextrin, having the same percentage composition as starch. If the boiling is carried on for some time a further change is noticed, and dextro-glucose is produced. One of the most interesting changes of starch into glucose is produced by diastase, a peculiar nitrogenised principle found in malt. The gelatinous starch is warmed to

71°C., and a small portion of malt in tepid water is added; in a few minutes the starch becomes limpid and clear, and glucose may be tested for by Fehling's copper solution.

$$3C_6H_{10}O_5 + H_2O = \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Dextrin.}}{2C_6H_{10}O_5}$$

Starch is insoluble in cold water and alcohol. Lime forms a weak compound with it, and free iodine and bromine combine with it to form coloured compounds. The iodine reaction is always used to show the presence of starch in vegetable tissue, and further it is used very extensively by chemists as an indication of the termination of certain reactions in the quantitative estimation of substances where potassic iodide is reduced.

DEEP BORING NEAR BIRMINGHAM.

A boring which is being executed at King's Heath by Messrs. Le Grand and Sutcliff, of 100, Bunhill Row, London, is of considerable interest as affording a good section of the division of the Triassic strata.

Drift - - - - - - -	62 feet.
Red marls - - - - - -	160 ,,
Ditto, with gypsum - -	123 ,,
Red and blue marls, with gypsum -	97 ,,

Thus the total depth now reached is 442 feet. In the letter from the firm by whom the boring is being executed (and to whom I am much indebted for the particulars), it is pointed out that the range of the gypsum bands, over a thickness of 220 feet (or rather less when the dip of the strata is taken into account), is somewhat unusual. I shall hope to be able to give particulars of the completion of this boring in another number.

W. J. H.

SOME RECENT OBSERVATIONS ON THE STRUCTURE OF ROWLEY RAG.*

BY T. H. WALLER, B.A., B.SC. LOND.

The microscopical structure of the great mass of basic igneous rock which we locally call Rowley Rag was described by Mr. Allport in the "Quarterly Journal of the Geological Society" for 1874, p. 548, so that on the general subject I

* Transactions of the Birmingham Natural History and Microscopical Society, read before the Meeting March 24th, 1885.

have no need to say more than that the constituent minerals are augite, a triclinic felspar, olivine and its decomposition products, with apatite, magnetite, and ilmenite subordinate in quantity but almost never failing in any part of the mass.

In a number of thin sections which I have from time to time prepared, I have, however, happened upon a few points of rather special interest relating to the structure of the mass in different parts; points, too, which have been attracting a good share of attention during the last few months as throwing some light on the causes which have brought about the curious changes in mineral character among the products of volcanic action in many districts when this is continued over long periods of time.

In one or two of my specimens there is a distinctly microporphyritic structure to be observed; large felspar crystals are scattered through a ground composed of very small crystals of felspar and augite, with a very large quantity of magnetite disseminated through the mass. This large quantity of magnetite is also found in a specimen from Tansley Hill, near Dudley, where the minute felspar crystals in a few places show most characteristic signs of the mass having been in motion after they were formed. They lie in streams, their lengths being to a good extent parallel to each other, while the grains of augite are of very small dimensions indeed.

There are very curious differences in the texture and composition of portions of the mass even close to each other. In the space of a circle of one inch in diameter, sudden changes from very coarse grain to quite fine may be observed. In some sections there is no trace of olivine, in others it forms a very important part; apatite is usually much more abundant in the coarse-grained parts than anywhere else; augite sometimes occurs in well-defined crystals showing eight-sided sections; sometimes it only fills up the spaces between the long blades of felspar.

I have examined the felspar by Szabo's flame reactions and find that the specimens tried were labradorite, but, of course, this does not exclude the possibility of the presence of other varieties.

Mr. Allport, in the paper mentioned above, describes certain red veins or masses, "evidently contemporaneous," as occurring in the midst of the black stone, and it is to these and certain grey veins which prove to be closely related to the red ones that I particularly wish to call your attention this evening. In a recent visit to the Hailstone Hill quarry I was fortunate enough to obtain specimens of one of these grey veins in such a good state of preservation that by both chemical analysis and microscopical examination it was possible to determine with facility and comparative certainty the relation which the veins bear to the mass of the rock. The particular vein which has furnished my specimens was about half an inch thick; it traversed a great detached block of stone, so that the extent of it could not be determined. When a thin slice is examined microscopically it is seen to consist of a network of beautifully clear, apparently quite fresh and unaltered crystals of felspar of much larger size than those which occur in the part of the rock in the immediate neighbourhood of the vein. The angular spaces among these are filled up with a clear colourless substance, which in many parts swarms with brownish dust (as seen with a low power), and is not altogether free from it in any instance. A few crystals of green augite, contrasted with the much browner augite of the normal rock, will also be observed, and a very small quantity of green and brownish fibrous materials, evidently the products of decomposition.

When polarized light is employed the felspar is found to be exclusively in either simple or only singly twinned crystals; the multiple twinning so characteristic of the triclinic felspars is, so far as I have observed, totally wanting. This, however, is not a positive proof as to the nature of the mineral, but the presence of orthoclase is proved by the fact that many crystals will be found on careful search which "extinguish" when their length is parallel to the principal planes of the Nicol prisms, and many of the twinned sections become dark in both halves together when in this position. As to sections which do not fulfil either of these conditions, they may be orthoclase or they may be triclinic. The chemical analysis of the vein also shows such a percentage of potash that from this alone we might have inferred the presence of orthoclase.

The felspar also occurs in the form of extremely slender crystals embedded in the dusty material previously mentioned, and these very fine blades are often slightly curved.

Still using polarized light, we shall find that most of the spaces between the felspars remain quite dark between crossed prisms in all positions; that, therefore, we have to do with a glassy residuary base. In a few places, however, this has a stringy, uneven look, coming near, I presume, to Rosenbusch's microfelsite, and in some others there is a very faint and vague polarization, evidently due in some cases to very fine films of felspar, but in others with a quite decided cryptocrystalline character.

It is important to notice the difference between this transparent perfectly colourless glass and the dark, almost opaque, glass which has resulted from the rapid cooling of masses of similar composition, and which goes by the name of Tachylyte. For purposes of comparison I have a slide cut from the artificial tachylyte which Messrs. Chance, of Oldbury, produced many years ago by melting and casting in moulds the rock under discussion. The difference is evidently owing to the fact that the oxides of iron to which the colour is due had, when these residual glassy patches solidified, been almost all removed by the previous separation in a crystalline state of magnetite and augite, so that the remainder is quite colourless.

When the dust mentioned above is examined with a high power it is seen that many of the individual specks are very irregularly shaped masses of some brown substance, and in a very few cases I believe there are circular clear bubbles in the inclusion, but the bubbles are immovable. In the description of a "Trachyte Pitchstone" from Cantal, in Central France, quoted from Von Lasaulx in Rosenbusch's "Mikroskopische Physiographie der massigen Gesteine," p. 162, the occurrence of patches of brown glass with bubbles in the midst of the colourless glass of the rock is mentioned as an unusual circumstance.

In the red veins the structure is exactly the same, but the glassy base is replaced by a fibrous radiating mineral, though whether it is an original product of the consolidation of the vein or a result of subsequent alteration of the glass it is not easy to decide.

There are a few brownish grains, of which I do not know the nature. They are slightly dichroic, have bright colours in polarized light even in very thin section, and stand out with the peculiar bold relief which shows a high refractive index. One of them shows one line, apparently a cleavage line, parallel to the sides of the section, and this one extinguishes parallel to the line. In another case the substance fills the angle between two felspar crystals; in another, a minute grain is shut into an augite crystal. The dichroism is not strong enough for mica, nor does the structure seem fibrous enough.

The colourless glass is by no means only found in the veins of which I have been speaking. Some of the slides which are exhibited show considerable quantities among the other constituents of the rock, especially in the parts where the crystals are large, and it appears always to be filled with a fine dust similar to that in the grey veins.

The analysis of the vein gives very curious and interesting results, which are tabulated below:—

	I. Sp. Gr. 2·79	II. Sp. Gr. 2·58
Silica	48·8	58·3
Alumina	18·1	17·9
Ferrous oxide ...	7·2	3·0
Ferric oxide ...	3·5	2·5
Lime...	8·4	2·1
Magnesia	4·9	1·9
Potash	1·9	5·9
Soda	3·7	5·2
Loss at red heat	3·6	2·7
	100·1	99·5

It should be mentioned that in these analyses the titanic acid is not determined; the silica and the alumina are therefore slightly too high, as the rock contains about two per cent. of titanic acid.

I. Gives the percentage composition of an ordinary specimen of the unaltered "Blue" stone close to the vein.

II. That of the vein in question.

We see, then, that the portions of the melted mass which consolidated last contain nine per cent. more silica, and a very much increased amount and different proportion of alkalis, with, as was to be expected, a lower Sp. Gr.

In a paper read to the Section in October last, and published in the "Naturalist" for January, 1885, I mentioned very similar relations as to composition between the main mass of the rock of Penmaenmawr, in North Wales, and certain grey or white veins, evidently contemporaneous, which occur in it; and the same has been described in the case of the great Cockfield Dyke of the North of England, with regard to the glassy residual base (see Mr. Teall's paper in the "Quarterly Journal of the Geological Society" for May, 1884). In the number of the "Geological Magazine" for March of this year Mr. Teall again shows that the glassy base of the hypersthene andesites of the Cheviots has the chemical composition of a quartz felsite, and contains five per cent. more silica than the general average of the rock.

He also throws out the suggestion that the quartz felsites of the district may possibly be the more acid parts left after the separation of a certain amount of crystals from the andesite magma, the separation having been effected either by the subsidence of the crystals or by the still fluid residuum being squeezed out from among them "as water from a sponge."

It is at any rate pretty well established that a molten siliceous magma from which crystals are separated in the process of cooling will become progressively richer in silica and alkalis and richer in potash relatively to the soda.

It is quite possible that we have in this phenomenon a hint as to the reason of rocks of progressively more acid character being formed in a given volcanic district, as is so frequently the observed fact. If a lava of medium acidity is being erupted it is conceivable that if the heat by which it has been kept fluid in the interior of the earth is so far reduced as to permit of crystallization taking place, any further eruption may only be able to bring to the surface the more acid, still fluid, residue, and by this means the character of the resulting rock masses would be gradually changed. The succession andesite, trachyte, rhyolite with increasing degrees of acidity is frequent in volcanic regions. In the foregoing remarks I have made use of the paper by Mr. Teall, in the "Geological Magazine" for March, which I have previously quoted, as the question is one of much interest, and I think our Rowley veins have a definite bearing on the subject as showing to what a great extent the differentiation of a cooling magma may proceed.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 235.)

GRAMINA.—*Continued.*

BRACHYPODIUM.

B. sylvaticum, *R. and S.* *False Wood Brome Grass.*

Native: On hedge banks and in woods. Common. July, August. Area general.

B. pinnatum, *Beauv.* *Barren False Brome Grass.*

Native: On banks, roadsides, and field borders in calcareous soils. Local and rare. July, August.

II. (*Festuca pinnata.*) Grafton! Great Alne! *Purt.*, i., 83; near Chesterton! Binton! *Y. and B.* Honington, near Wayland Coppice; Lambcote, *Newb.;* Napton-on-the-Hill; near Birdingbury; Kineton; Compton Verney; near Alveston Pastures; Binton; Temple Grafton; Wixford; Exhall; Red Hill; Drayton; Billesley; lane to Snitterfield from Wilmcote; Morton Bagot.

b. pubescens. Rare.

II. Roadsides near Kineton; Steeple Hill and Marl Cliff, near Bidford.

AGROPYRUM.

A. caninum, *Huds. (Triticum). Wood Couch Grass.*

Native: On hedge banks and in bushy places. Local. July.

I. Wylde Green, near Sutton; Waterworks grounds, Witton Lane; coppice, near Plant's Brook; lane by Chelmsley Wood; canal bank, Olton; Elmdon; banks by Meriden Marsh; Shelly Lane, near Shirley.

II. Myton, *Y. and B.;* Honington Park! *Newb.;* Barby Road, near Rugby, *R. S. R.*, 1876; lane from Edge Hills to Radway; Marl Cliff, near Bidford; Chesterton Wood; road from Rugby Mill to Newbold-on-Avon.

A. repens, *Linn. (Triticum.) Common Couch Grass.*

Native: On hedge banks, by roadsides, and in bushy places. Common. July, August. Area general.

LOLIUM.

L. perenne, *Linn. Common or Perennial Rye Grass.*

Native: In meadows, pastures, on banks, and by roadsides. Common. June, July. Area general.

[*L. italicum*, Braun. *Italian Rye Grass.*

Alien: By roadsides, and on railway banks and sidings. Rather common. July to September.

I. Railway sidings between Castle Bromwich and Sutton; Gravelly Hill; roadsides near Shustoke; quarries, Hartshill; lanes near Solihull; &c.

II. Honington and Tredington (escape), *Newb.;* plentiful between Stratford-on-Avon and Shipton; Alveston Heath; railway cutting, Alcester and Salford Priors; &c.]

Apparently well established in many of the districts, but probably always a mere straggler from cultivation.

L. temulentum, Linn. *Darnel.*

Casual: In rick yards, and on waste places. Very rare. July.

II. Waste places near Kenilworth, *H. B.;* rick yard at Kenilworth, abundant.

b. arvense. Very rare.

II. Waste places near Kenilworth! *H.B.* Rick yard at Kenilworth with the type.

Neither of these varieties is truly wild in this county.

HORDEUM.

H. pratense, *Huds.* *Meadow Barley.*

Native: In pastures and grassy roadsides. Rare and local. July, August.

I. Pastures near Curdworth; pastures near Stonebridge; meadows near Blythe Bridge, Solihull; Bradnock's Marsh.

II. Bishop's Itchington, *Y. and B.;* Honington; Tredington, *Newb.;* Holbrook Park, *R.S.R.*, 1877; pastures near Kineton; Moreton Morrell; Alveston; Stratford-on-Avon; Binton; Exhall; Oversley; Billesley; Great Alne; Wilmcote; Henley-in-Arden; Combe Fields, near Rugby; Birdingbury; Shuckburgh; Willoughby.

H. murinum, *Linn.* *Wall Barley.*

Native: On dry banks, by roadsides, more especially by towns and villages. Locally common. June to August.

I. Sutton Coldfield; Minworth; Curdworth; Olton canal bank;

II. Warwick! Myton! Kenilworth! Emscote, *H.B.;* Honington! Tredington! *Newb.;* Alveston Heath; Stratford-on-Avon; Binton; Wixford; Salford Priors; Oversley; Drayton; Wootton Wawen; Lillington; Rugby; Radford Semele; Long Itchington.

Very local and sparse in district I.

NARDUS.

N. stricta, *Linn.* *Mat Grass.*

Native: On damp heaths, and heathy roadsides. Rare. May to July.

I. Sutton Coldfield! *Ick. Anal.*, 1837; Coleshill Heath! *Perry Fl.;* Middleton Heath; Coleshill Pool; pasture, Blythe Bridge; pasture by Olton Pool; Marston Green; Baddesley Common; abundant, Forshaw Heath, near Tanworth.

II. Studley Common, *Purt.*, i., 66; Haseley Common, *Y. and B.;* Kenilworth Heath! *H.B.;* Yarningal Common.

(To be continued.)

METEOROLOGICAL NOTES.—July, 1885.

The barometer was generally high during the month, the mean, 30·181 inches, being higher than that of July in any of the last six years, and the highest since January, 1882. The greatest pressure was on the 22nd, 30·453 inches; the least, on the 19th, 29·786 inches. Temperature was about 1 degree above the average, but the maxima were unusually high. The highest readings were on the 25th, when 90·0° was recorded at Henley-in-Arden, 89·2° at Loughborough, 87·2° at Strelley, 86·0° at Hodsock, and 85·0° at Coston Rectory. 89·7° was registered at Loughborough on the 5th of July, 1881. In the rays of the sun, 141·2° at Loughborough on the 26th, 135·2° at Strelley on the 19th, and 133·7° at Hodsock on the 26th. The lowest minimum readings were 38·0° at Coston Rectory on the 2nd, and at Henley-in-

Arden on the 9th, 40·0° at Hodsock on the 29th, 42·1 at Strelley on the 1st, and 43·7° at Loughborough on the 2nd. On the grass, 32·7° at Hodsock on the 29th, 37·8° at Strelley, and 40·0° at Loughborough on the 1st. The past month is most remarkable for the unusually small amount of rainfall, the total values being, at Coston Rectory 0·11 of an inch, at Loughborough 0·14, at Hodsock 0·32, at Strelley 0·37, at Henley-in-Arden 0·55. The number of "rainy days" varied from 2 to 6. An exceptional fall, 0·40 of an inch, took place at Henley-in-Arden on the 21st. The absence of thunder storms is noticeable. Sunshine was above the average.

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Natural History Notes.

NEW BRITISH FUNGI.—I was surprised to-day, on examining some fungi, collected at Sutton last March, to find that one of them was a species of Helminthosporium, new to Great Britain. It resembles *H. Hirudo*, Sacc. (Fung. Ital. 54), but differs in being nearly twice as large; the spores are about 400 μ long, very dark, with about 60 septa. I propose to name it var. *Anglicum*. I have also to record the following fungi, not hitherto, I think, detected in Great Britain: *Phoma ilicicola*, *P. lineolata*, *P. hysterella*, and *Septoria Teucrii*, all from near Hampton-in-Arden.—W. B. GROVE, B.A., July 28th.

DEATH'S HEAD HAWK MOTH.—Two broods of caterpillars of the death's head hawk moth *(acherontia atropos)* have occurred here, the first I have met with during a residence of five-and-twenty years. One of these specimens was brought in by the vicar of Kingsbury, found by a labourer at the edge of a field of potatoes. The other three were taken feeding in a potato garden, close by the Tamworth railway stations. I attribute this appearance to the unusually dry summer we have experienced.—EGBERT DE HAMEL, Bole Hall, Tamworth, August 15th, 1885.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, July 28th.—Exhibits:—Mr. W. P. Marshall, M.I.C.E., geological specimens from America. Silicified wood, from Calistoga Petrified Forest, California, special piece showing fine concentric layers when magnified; Sulphur deposits, &c., from Hot Springs, Cloverdale, California, where sulphur vapour and steam issue from cracks in ground; weathered granite, from Yosemité Valley, California, spherical layers from domes, flat layers from vertical faces; granite sand, from Yosemité Valley, California, dust lying thick upon roads below granite cliffs; weathered sandstone, from Garden of the Gods, Colorado, red portion a little harder than white, forms flat caps; granite, &c., from Rocky Mountains, Pike's Peak, Colorado, partially disintegrated, and some deep red coloured granite, &c., from Rocky Mountains, Toltec Gorge, Colorado; striped sandstone from rocks, Kentucky; sundry specimens from rocks at Great Salt Lake, Utah;

sundry specimens from rocks above Santa Fé, New Mexico; Limestone, from Manitou Cavern, Colorado, cave in limestone rock, similar to Mammoth Cave, Kentucky; ironstone from rocks above Las Vegas, New Mexico; copper ore, from Rocky Mountains Slope, Arizona, too great distance and not rich enough to pay carriage; limestone and shales, from rocks forming Niagara Falls—the shale perishes below the limestone, causing the limestones to break down. By Mr. Clarke, a slide of pond life, from King's Norton excursion, July 25th, containing *Bosmina longirostris*, *Diaptamas Castor*, *Volvox Globator*, *Spirogyra neglecta* in conjugation, *Anuræa stipitata*. By Mr. Bolton, Plumatella, from King's Norton. By Mr. Udall, a trilobite (*Calymene Blumenbachii*), from Dudley.—GENERAL MEETING, August 4th. Mr. J. Morley exhibited a fasciated stem of vine, showing its gradual division into the normal condition; also a sprig of maple (*Acer campestre*), in which the leaves were covered with the bright red galls of an insect (*Cynips*). Mr. T. Bolton exhibited *Lemanea fluviatilis* and *Batrachospermum moniliforme*, var. *pulcherrimum*, freshwater algæ, from near Llangollen; also *Daphnia reticulata*, from Sutton. Mr. W. B. Grove, B.A., exhibited the following plants from North Wales:—*Cotyledon umbilicus* (2 feet high), *Orobanche hederæ*, *Saxifraga stellaris*, *Sedum Telephium*, *Sedum anglicum*, *Drosera rotundifolia*, *Verbena officinalis*, *Orchis maculata*, *Narthecium ossifragum*, *Wahlenbergia hederacea*, *Sambucus Ebulus*, *Myrica Gale*, *Blechnum spicant*, *Asplenium Adiantum nigrum*, *Asp. Trichomanes*, *Lastrea montana*, *Polypodium Phegopteris*, *Lycopodium clavatum*, *Lyc. Selaginoides*, *Hygrophorus conicus*, *Boletus luteus*, *Helotium æruginosum* (oak impregnated with mycelium), and *Cantharellus cibarius*.—BIOLOGICAL SECTION, August 11th.—Mr. R. W. Chase in the chair. Mr. T. Bolton, F.R.M.S., exhibited *Pteronais parasita*, vulgarly known as the Polite Worm, in allusion to its habit of nodding its head and flapping its apparent wings; and *Alcyonella fungosa*, both from Alvechurch. Mr. J. E. Bagnall, A.L.S., two mosses, *Amblystegium serpens* and *Bryum cæspiticium*, curious from growing at a rolling mill, Buckingham Street, amid the splash of a mixture of vitriol, oil, and water; also a number of mosses from Cumberland and some flowering plants from the Anker district. Mr. J. Levick, *Zoothamnium arbuscula*; *Lacunularia socialis*; *Cristatella mucedo*; from Alvechurch. Mr. Browett, large female adder, *Pelias Berus*, measuring fully two feet long, together with eight young adders, measuring six inches long, taken from the inside of the mother after being killed, in the usual membrane, forming a complete egg.—GENERAL MEETING, August 18th.--Mr. T. Bolton exhibited *Verbascum Lychnitis*, the white mullein (rare), from Whittington, Kinver, and *Sabella penicillus*, a marine tube-dwelling worm, from Sheerness. Mr. J. F. Greenway exhibited *Lacinularia socialis* and *Stephanoceros Eichhornii*, from near Alvechurch. Three new members were elected.—GEOLOGICAL SECTION, August 25th.—Mr. Pumphrey exhibited a Potentilla, in which, instead of a solitary flower, two grew back to back with complete calyx and corolla. Mr. Bolton on behalf of Mr. Morley, from Llandudno, a dog-fish egg, Botryllus, and young crabs. Mr. W. B. Grove, *Lentinus lepideus*, an agaric which usually grows upon imported fir timber, but is found annually at Selly Oak, on the beams of the roof of a half buried cellar. Mr. Udall, several corals from neighbourhood of Bristol; specimen of coal from Swansea; specimen of granite from Shap.

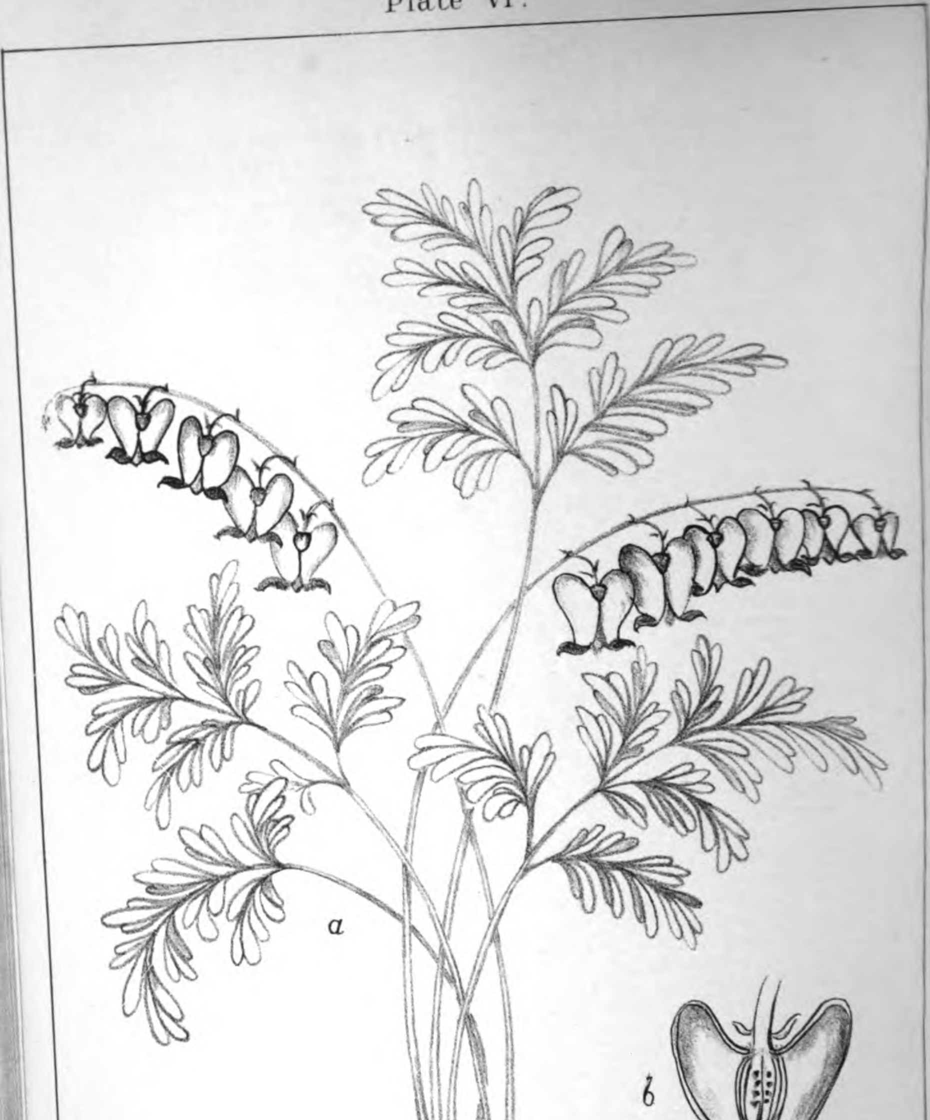
BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 20th. Mr. Hawkes showed specimens of meadow sweet attacked with *Uromyces ulmariæ* and *Triphragmium ulmariæ*. Mr.

Madison, specimens of henbane, *Hyoscyamus niger*, from Solihull; also specimens of *Vertigo pygmæa* from Knowle. Under the microscopes Mr. Tylar showed a section of the ovary of snapdragon; Mr. Hawkes, *Triphragmium ulmariæ*. A paper was then read by Mr. J. A. Grew on "An Insect," in which he described the vague and indefinite notions many persons had upon this subject, notions that were shared by many writers of only a few years ago. He defined the position and distinguishing features of the section Insecta of the animal world. The remaining part of the paper was taken up with a description of the peculiarities of their structure, and concluded by remarking that much yet remained to be done in working out the uses of some of the organs. The paper was illustrated by diagrams.—July 27th. The following exhibits were made by Mr. Madison: Specimens of *Ancylus fluviatilis*, var. *compressa*, from Weatheroak Hill; also a case of specimens of *Gryphea incurva* from various localities. Mr. Evans, a fossil shell (*Modiolopsis*) in a pebble from the Moseley drift. Mr. Sanderson, a series of photographic views of the Yorkshire dales, etc. Under the microscopes Mr. Tylar showed a zoophyte, *Obelia dichotoma*, with polypes *in situ*. Mr. J. W. Neville, ruby sand with fluid cavities, from New Zealand.—August 10th. Mr. Moore exhibited six well-marked varieties of *Arion ater* from the Isle of Man. Mr. Hopkins, specimens of *Valvata cristata* and *Helix sericea*. Mr. Hawkes, leaves of violet infested with Trichobasis, and leaves of *Tragopogon pratensis* attacked by Æcidium and Ustilago. Mr. Madison, a number of shells collected at Dovedale, including specimens of *Helix arbustorum*, var. *cincta*, also var. *flavescens*; *H. ericetorum*, var. *minor*; *Ancylus fluviatilis*, var. *alba*; etc., etc. Then followed a paper, "Notes on the Green Woodpecker," by Mr. P. T. Deakin. The writer described the habits of the bird, and the order to which it belonged. The peculiarity of the legs and claws was pointed out as adapted to the habit of climbing and supporting the bird while it obtains its food, which is procured by tearing off the bark of trees, and consists of the larvæ of wood-boring beetles, etc. The habits of nesting, colour of eggs, plumage of young, etc., was dwelt upon, and the whole illustrated by wall pictures and stuffed specimens of the green woodpecker and its allies.—August 17th. The President in the chair. Mr. Deakin exhibited a collection of shells from the King's Norton district. Messrs. Madison and Hopkins, specimens of *Helix rotundata*, var. *alba*, and *Clausilia rugosa*, var. *albida*, the latter new to the district. Mr. Tylar, a zoophyte in spirit, *Aglaosphenia myriophyllum*. Mr. Delicate, two plants, one a native rose from Manitoba. Under the microscopes Mr. Moore showed palates of *Zonites cellarius* and *Neritina fluviatilis*. Mr. J. W. Neville, the brittle starfish, *Ophiocoma neglecta*. Mr. Hawkes, a type slide of five micro-fungi, showing degrees of complexity of spores from Puccinia to Xenodochus. Specimens of the infested plants were also exhibited.

CARADOC FIELD CLUB.—On Wednesday, June 17th, this club made the second excursion of the season to Bishop's Castle by railway, thence proceeding by carriages to the Bishop's Moat, an extensive earthwork on the extreme border of the county, consisting of a lofty mound raised for a point of observation and signalling, surrounded by a ditch, and protected by a camp, which it joins, also surrounded by a ditch. The Bishops of Hereford, somewhere about the eighth century, had a large estate granted to them of 18,000 acres by Egwin Shakehead, which being in near proximity to Wales, they had to defend, for which purpose they utilised this, probably already existing, earthwork, hence the name Bishop's Moat. Near here were found growing *Narcissus poeticus*, *Viola lutea*, *Orchis morio*, *Heracleum sphondylium*, form *angustifolium*, Sm., and *Prunus padus*, the fruit of which was strangely deformed by a fungus—*Ascomyces Pruni (Tul)*, not hitherto (we think) recorded for Britain. The fruit was elongated so as to resemble the pod of a *Genista*. The party then visited another ancient encampment, Cær-din, commanding a magnificent view of Corndon mountain and stiperstones. Mr. R. Parry gave an interesting address on the geological features of the surrounding district, in the course of which he pointed out the changes it had undergone since Corndon was an active volcano. The President, the Rev J. D. La Touche, supplemented these remarks by a highly interesting address, confirming Mr. Parry's views. Offa's Dyke was the next object of interest, which is in wonderful preservation here, and impressed all minds with the magnitude of this Saxon boundary. The Hon. Secretary, the Rev. T. Auden, read an excellent paper on its construction, extent and object, and the traditions pertaining to it. The third excursion was to Dolgelly, July 28th to 31st, when Cader Idris was ascended, where many botanical treasures were seen, but treated with due forbearance. It was gratifying to see that many rare plants still hold their own in the wilder parts of this noble mountain, in spite of the rapacity of some calling themselves botanists. Cymmer Abbey, the Vale of Ganllwyd, Pistyll-y-Cain waterfall, and other picturesque localities were visited on the second day, and altogether the members of the club had a most enjoyable time.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—A large party of the members of this Society and their friends visited Buildwas and Wenlock Abbeys on Tuesday, the 18th of August. After seeing the ruins of Buildwas, the members were permitted by the kindness of Mrs. Moseley, who lives in the Abbot's house, to go into her hall, which is paved with ancient tiles found in the Abbey ruins. These are very curious, several having the pattern traced upon them with a style before being baked. Between Buildwas and Wenlock, the Bradeley Limestone Quarries were visited, where a number of characteristic Wenlock fossils were found, including *Euomphalus discors*, *Favosites Gothlandicus*, and *F. Forbesi*, *Heliolites megastoma*, and *H. interstinctus*, *Atrypa reticularis*, *Orthis*, *Cyathophyllum*, *Stromatopora*, &c. At Wenlock, after examining the ruins of this once famous and extensive Abbey, by the permission of C. M. Gaskell, Esq., the members went over the Prior's House, now Mr. Gaskell's residence. The house contains a great deal of original old furniture and wood-carving, formerly belonging to the Abbey. In the course of the day the botanists found the following plants:—*Chelidonium majus*, *Cheiranthus cheiri*, *Hypericum hirsutum*, *Agrimonia eupatoria*, *Poterium sanguisorba*, *Anthyllis vulneraria*, *Genista tinctoria*, *Pimpinella saxifraga*, *Ononis arvensis*, *Sedum reflexum*, *Dipsacus pilosus*, *Arctium majus*, *Picris hieracioides*, *Artemisia absinthium*, *Lactuca muralis*, *Erigeron acris*, *Inula conyza*, *Chlora perfoliata*, *Senecio erucifolius*, *Sclerochloa rigida*. The Rev. J. H. Thompson exhibited *Lysimachia vulgaris*, from Moccas Park, Herefordshire, and a plant he believed to be *Sparganium neglectum*, lately described in the "Journal of Botany" as new to the British Flora, from Hurcott, Kidderminster. Mr. Horace Pearce exhibited *Silene maritima*, in flower, from Pwllheli; *Verbascum Lychnitis*, *Potentilla argentea*, and *Plantago Coronopus*, from Whittington, near Kinver; *Erodium maritimum*, from Habberley Valley, Kidderminster.

Plate VI.



W.H.W.

ALD PRESS. IMP.

W.B.G.

DICENTRA CUCULLARIA

Plate VII

HERALD PRESS. IMP.

TRILLIUM GRANDIFLORUM.

W.B.S.

NOTES ON THE FLORA OF AMERICA,*

MADE DURING A TOUR IN THE NORTH-EASTERN STATES IN APRIL, MAY, AND JUNE, 1882.

BY W. H. WILKINSON,

HON. SEC. BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

On landing in New York City in the middle of April, we were surprised at the beautiful weather, for the sky was almost without a cloud, and the deep blue contrasted with the red brick buildings most vividly; the clearness of the atmosphere was perhaps partly due to climatic causes and partly to the use of anthracite coal, which makes no smoke; the result being very favourable to the cleanliness of the buildings and to the purity of the atmosphere.

New York is built on a tongue of land some eleven miles long, the southern portion of which is covered to a considerable depth with sand, thus causing much trouble and expense in getting good foundations for their buildings; and also is not favourable for the growth of the ornamental trees and flowers in the southern and busiest portion of this great city, but as you advance further north the schistose rock can be seen cropping up, so that in Central Park there is a fine state of cultivation attained and many rare plants and trees are grown; the Park is laid out with great skill, some parts being depressed and filled with ornamental lakes, and others raised and embellished with statuary and rockeries, the National museums being situated in isolated blocks within the park enclosure.

Our first introduction to the flowers of America was in one of their most appropriate places, viz., in the adornment of the ladies' dresses, it being the fashion in New York City to wear eight to ten full-blown roses grouped on the front or side of the dress, as they walked "on Broadway" or Fifth Avenue. It must have been a costly luxury then, as there

DESCRIPTION OF PLATES.

PLATE VI.—*Dicentra cucullaria* (White Ear-drop). Flowers white, with velvety maroon tips. A beautiful and delicate woodland plant, growing on islands, Niagara Falls. (*a*), Plant, half natural size; (*b*), section of flower with six stamens; (*c*), scale-stem.

PLATE VII.—*Trillium grandiflorum.* Flowers usually white, sometimes pink. Frequent in shady woods, Niagara Falls, &c. (*a*), Centre of flower; (*b*), stamens, tripartite stigma; (*c*), part of leaf, showing the palmi-net-veined structure.

* Transactions of the Birmingham Natural History and Microscopical Society. Read March 31st, 1885.

was no sign of growth amongst the flower gardens of the district; all were grown under glass, and realised from 1s. to 2s. each blossom in the shops.

Our first impression of the American landscape was its similarity to our English scenery, being composed of trees, shrubs, flowers, and grass, most of which from a distance looked about the proportion, size, and colour of those at home; but on closer examination every one seemed a little different in some detail or other, the trees differed in species, the flowers in form and colour, and even the grasses, which were mostly coarser than ours. Perhaps a few illustrations from some of our commonest and best known flowers will best enable us to realise this difference.

The nurserymen seem to grow most of our greenhouse flowers, and to about the same state of perfection; but the private conservatories appear to be much neglected; the "mighty dollar" evidently engrosses the attention of "paterfamilias." But the alteration of climate makes a great change in out-door flowers; they have a far greater amount of heat in the summer and a much more intense frost in the winter than we ever get. Hence a number of plants which do well with us die directly with them; for instance, we consider the ivy a common hardy plant, but it dies if exposed to their winter frosts, and they cultivate it in pots to ornament their houses and train round the inside of their windows. Again, the most common—and by the children the most prized—of flowers is the English daisy, *Bellis perennis.* But although I looked carefully, I never saw one in America; I suppose the winter kills them, and even if they survive the frost, the drought of August would kill them. Once I thought I had found one, but on gathering it it was quite a different plant (*Aster spectabilis*), but I have laid it before you to-night that you may see how very much the blossom resembles our pretty English daisy.

Now, on the other hand, the garlic is not very common with us, while it has been taken over from Europe to New York, and has now spread for 200 miles inland and grows as common there as grass. The hawthorn was also absent, their hedges being made of other shrubs near the towns, but in the country either by trees cut from the forests forming a "snake" fence or by galvanised wire, certainly not very picturesque, however economical it may prove to the farmer. The golden buttercups were scarce but I gathered four different kinds, but none grew in the rich profusion of our field buttercup.

I was much charmed with the beauty of the peach blossoms; near Baltimore large tracts of land are given up to their cultivation; the deep pink blossoms coming out before the leaf. The finest growers only crop their trees for three years, then replace them, but the amount of fruit grown is enormous, as you may judge when I tell you that the carriage of peaches in two months pays the dividend on a branch line for the whole twelve months. At Baltimore 10,000 persons are employed to "can" the peaches and oysters, which are brought up Chesapeake Bay, and are then sent out all over the civilised world.

In some places the dandelion (*Taraxacum dens-leonis*) was growing in great abundance; for instance, it gave quite a gay effect to the greensward of the public park at Pittsburg; and perhaps some of our friends who are not epicures will be surprised to hear that dandelion salad is quite a recherché dish. The Yankees are great upon oysters; immense quantities are eaten in the large cities, and you will often find them cooked in four or five different ways; and as if not satisfied with Father Neptune's supplies they grow oyster plants, but I did not appreciate them, the flavour reminded me so much of parsnips.

The size of their country, stretching far into the tropics, and their vast railway systems, afford to New York a supply of fruits and fish that perhaps no other city has ever dreamed of. In London, I know, you can buy simply anything, but you must pay for it; but here in New York the quantity is equal to the demand, and hence is obtainable by all.

At Philadelphia, near to Independence Hall, where the Declaration of Independence and many relics of the Rebellion of 1776 are most carefully preserved, is Washington Square, which is said to contain a specimen of each of the trees which grow in the States; but if ever such a collection was planted there a vast number must have perished, as there is little left to make it attractive now. But just outside the city is Fairmount Park, which extends along both banks of the Schuylkill River, is seven miles long, and is said to be the finest park in the world.

In Washington the streets are wide and flat and paved with asphalte, and are mostly planted with two rows of trees; some of the avenues are lined with the White Poplar (*Populus alba*), the cottony seeds of which were blowing about and piled into heaps like snow in a snowstorm. At Washington we visited the far-famed Smithsonian Institute, with its fine collection of specimens, the conservatory of which contains, besides a fine group of Australian ferns, 110 species of palm trees and the finest collection of insectivorous plants I have met with.

I might mention here a curious incident. For the previous month we had been travelling northwards at about the same rate that the spring advanced; for instance, on May 3rd, in Washington, we saw the lilac and chestnut trees in bud, just ready to burst out; and in every town we visited we found them in just a similar state, even to Montreal on June 3rd, but during the week of our stay here, summer broke upon us in all its glory and beauty, so we were at once plunged from early spring right into the heat of midsummer; and from this point during the whole of June, as we pursued our course southward through the valley of the Adirondack, crossing Lake George and along the valley of the Hudson River to New York, we were delighted in the extreme with the abundance, the luxuriance, and the freshness of Flora's gems.

During the earlier part of our tour there were but few flowers in blossom, but by the time we reached Niagara Falls the spring had advanced considerably, so that I was able to obtain from there many very beautiful flowers, mostly new to me. I worked carefully up the Canadian shore of the Falls for some miles, and also the charming groups of the Cedar and Clarke Hill Islands as far as the Burning Spring. Another charming spot was the St. Helen's Island, in the St. Lawrence River, and Mount Royal at Montreal; and a third delightful and successful locality was the Lake George district, near the Adirondack Mountains, including the Au Sable Chasm, a perfect paradise to the botanist, and indeed to anyone else with a love of Nature.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 255.)

Some Sections Illustrating the Development of the "Spinatus" Zone and Transition Bed.

Sections in the "*Spinatus*" *Zone* are much more numerous than in the *Margaritatus*, but they seldom show anything below the rock-bed. This is chiefly due to the fact that the rock-bed is the only portion of the Upper Middle Lias that is now used in the district. It may be well, perhaps, to state here that by some geologists the rock-bed is regarded as itself constituting the "*Spinatus*" *Zone*.

On looking at a geological map of Northamptonshire it will be noticed that the Middle Lias outcrop takes a direction approximately from north-east to south-west, but that there is a considerable easterly extension of it fairly parallel with and on both sides of the River Nen, to within about two miles of Northampton. Over very much of the area which is shown as Marlstone in the maps of the Geological Survey there is a thin capping of Upper Lias* which, although ignored, is rather important as affecting the quality of the rock below, and the amount of water received by it.

Beginning at the extreme south-western portion of the county, we find a most interesting exposure of the rock-bed at King's Sutton. The rock here is rather rich in iron, and was for some time worked as an ironstone. This quarry has yielded more rare and interesting fossils than any other in the county; they include *Ammonites spinatus* (certainly rare in Northamptonshire), a large *Pleurotomaria*, *Trigonia Lingonensis*, *Crania Griffini*, *Spirifera oxygona*, *Spiriferina Walcottii*, *Spiriferina rostrata*, three species of *coral*, and a *dichotomous Ceriopora*. Most of the commoner fossils are also found, and some in abundance.

The King's Sutton section and many others in the neighbourhood of Banbury have been described by Mr. T. Beesley, F.C.S.,† and Mr. E. A. Walford, F.G.S.,‡ and I gladly ackowledge the assistance I have received from their pamphlets, particularly Mr. Walford's, as treating of sections chiefly in Northamptonshire.

The King's Sutton quarry has been so long disused that comparatively little can be got there now. A somewhat similar section may, however, be examined on the other side of the valley, at Adderbury.

There are three or four sections near to Thenford, and one rather a good one, although on first visiting the neighbourhood I was assured by an inhabitant that there were no stone pits about. The section is as follows :—

Section of Quarry South of Thenford.

	Feet	In.
1.—Soil	1	0
"*Communis*" *Beds*—		
2.—Light-coloured marly clay, with many small *Ammonites* and *Belemnites*	2	6

* See sections to follow.

† "A Sketch of the Geology of the Neighbourhood of Banbury," by Mr. Thos. Beesley, F.C.S.

‡ "On Some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford.

Both published by the Warwickshire Naturalists' and Archæologists' Field Club.

"Serpentinus" Beds—

3.—Lower Cephalopoda Bed; a white limestone with reddish exterior, containing many *Ammonites of the falcifer group*	0	6
4.—Light-grey clay or shale with red streaks in it ...	0	10

Fish and Insect Beds—

5.—Grey shale ... ... 1¾in.		
6.—Red sandy shale ... ... 2¼in.	0	4
7.—Fish-Bed, very soft, only a little hard piece in the middle, sometimes nodular, shaly, not persistent, containing *fish scales*, &c.	0	2

Transition Beds.

8.—Red sandy clay, shaly at top	0	7
9.—Transition-Bed, not distinctly separable from the bed below		
"Spinatus" Zone of Middle Lias.		
10.—Rock-Bed, a hard ferruginous rock, much of it of a bluish green colour, fossils very abundant, *Belemnites paxillosus*, *Rhynchonella tetrahedra*, *Terebratula punctata*, *Waldheimia resupinata*, *Ostrea sportella*, &c.... ...	6	0

The beds 5 and 6, and the upper part of 8, I believe to represent the *paper shales* of Gloucestershire, for fish remains seemed about as common in bed No. 5 as in the fish bed itself, though they were not abundant in either. In the rock-bed there are two or three layers composed almost entirely of *Rhynchonella tetrahedra*. These layers are called "*Jacks*" by the quarrymen in Rutland, and the term is now frequently used by geologists.

About two hundred yards west of the section above described is another, which is about as follows:—

	Feet	In.
1.—Soil and rubbly stone—disturbed rock	2	9
2.—Rock-bed, not very ferruginous, very rubbly, near the top two irregular bands of ossicles and broken shells. Most of the fossils casts. *Pectens*, *Rhynchonella tetrahedra*, *Terebratula punctata*, &c. No "Jacks."	3	6
3.—Red sand, which is either the base of the rock-bed or a sandy layer in it. The best specimens of Terebratula and Rhynchonella were got from this... ... ... shown	1	0

The badly preserved nature of the fossils at this quarry is no doubt due to the absence of a clay capping.

When the first of the two quarries just described was being worked some twenty years ago a small fault was noticeable; and a figure of it occurs in the "Memoirs of the Geological Survey," description of sheet 45 of the maps. In this diagram the Upper Lias, with two of the limestone bands near its base, are shown abutting against the Middle Lias rock-bed at an angle of about 30°. The faulting was thought to be very slight, and the geological maps show only a very small patch of Upper Lias let in. The construction of a well some fifty yards northeast of the quarry has, however, shown that the fault is much more extensive than had been anticipated, for the well being commenced about thirty feet above the level of the brook, passed through sixty-five feet of blue clay before water was obtained. The blue clay was very unfossiliferous; but Mr. Beesley, who was consulted in the matter, before water was obtained, identified it as Upper Lias by the *foraminifera* it contained; this was afterwards confirmed by other fossils from the lower part. Mr. Beesley says, in a paper he read before the Banbury Natural History Society, that not far from this spot a well was sunk fifty feet in vain, and water only obtained by boring, when it rushed in with great violence; also, that some wells at Lower Middleton Cheney are eighty feet deep, thus pointing to a probable extension of the fault in that direction.

The Marlstone rock-bed is again met with in its normal position in THENFORD, about a quarter of a mile north of the quarry; indeed, the main street has been partly cut through it, and it forms the foundation of walls of houses both here and at Middleton Cheney.

About a quarter of a mile west of Thenford there is another Marlstone quarry (Boucher's Pit), long disused, however. A distinct band of ossicles occurs about two feet from the top, the thickness of the entire bed being about five feet. It is capped by the Serpentinus and Fish and Insect beds, as in the quarry south of Thenford; the Fish bed is, however, much better preserved.

Still another quarry is to be seen a little way out of Thenford towards Middleton Cheney, but from long disuse very little besides the *Communis beds* of the Upper Lias can be now examined.

Near to MIDDLETON CHENEY we again find Marlstone quarries, though few of them show signs of having been worked recently. To the north-east of the village there is a small quarry, called the Rectory Pit, presenting the following section:—

Rectory Pit, Middleton Cheney.	Feet	In.
1.—Soil	1	6
Upper Lias.		
2.—Marly clay, light coloured, with pieces of white limestone in it—the remains of the Upper Cephalopoda Bed; *small Ammonites* of the planulate group abundant	2	0
3.—White limestone, containing many *Belemnites* and *Ammonites*, the latter chiefly of the falcifer group; also *Nautili*, &c. (The Lower Cephalopoda-Bed)	0	6
4.—Shale or clay containing a few *Belemnites*... ...	0	1½
5.—Sandy limestone—(Fish-Bed)	0	4
Middle Lias.		
6.—Grey marl, containing *Ammonites acutus*, *A. Holandrei*, &c.	0	2
7.—Marlstone Rock-Bed, with the usual fossils:— Bands of *Rhynchonella tetrahedra*, *Waldheimia resupinata*, *Ossicles*, &c.		

In an adjacent field is another Marlstone pit, which, having been more recently worked, presented a better section of the rock-bed. The section was as below:—

1.—Soil, with fragments of the Lower Cephalopoda-Bed containing the usual fossils, and also the rarer ones *Rhynchonella jurensis?* and *Dentalium liassicum.*

2.—Red clay; true transition-bed indifferently shown.

3.—Rock-Bed, rubbly, weathered surfaces rather red, most of the fossils particularly large. *Belemnites*, *Pecten æquivalvis*, *P. liasinus*, *Hinnites*, *Plicatula spinosa*, *Rhynchonella tetrahedra*, *Terebratula punctata*, *Bands of Ossicles*, *Pebbles*, *&c.*

Near the above, and beside the road leading across the hill to Chalcomb is another small pit showing only the rock-bed, and that not very well. The following fossils were noticed—*Pecten æquivalvis*, *Plicatula spinosa*, *Terebratula Edwardsi*, *Rhynchonella fodinalis*, *R. tetrahedra*, *Ossicles*, *Pebbles*, *&c.* We were informed that the Wesleyan chapel at Chalcomb was built with stone obtained here.

On the top of the hill, towards Chalcomb, the rock-bed forms the subsoil, and pieces of the rock are plentifully strewn on the ground; also a small quarry may be seen, exposing a section of three or four feet; it is very similar to that at the base of the hill. Here, and at other places around Chalcomb, the Middle Lias rock-bed seems to follow the undulations of the ground, and is met at such different levels as to suggest that the hills are due to elevation and not to denudation as in most other places in the county.

In and around Chalcomb there are several sections of the Marlstone; one by the side of the Thorpe Mandeville road shows a small fault; the light-coloured clay of the lower part of the Upper Lias being brought, for a short distance, side by side with the rock-bed. Another section in the village exposes about five feet of a rather soft rubbly stone, containing many fossils of the common kind, also calcspar. On a hill to the south-east of Chalcomb there are two or three small quarries, and a year or two ago one in the middle of a cornfield was being worked for road metal. In the district around Chalcomb there is no clay capping to the rock-bed, hence the stone is very much fissured and broken, and fit for little besides road mending; it has, however, furnished a rich red soil, very well suited to wet seasons because of the very good natural drainage it allows. On making enquiries I was informed that this district suffered very little from the heavy unseasonable rains of a few years back.

I believe there are no exposed sections of the Marlstone north of Chalcomb until we reach Edgcott, a distance of about 2½ miles. Near to Edgcott Church we find a small quarry that is occasionally worked for road material. The soil above it contains broken pieces of limestone, with *Ammonites serpentinus*, *A. communis*, *&c.*, which are evidently the remains of the Lower Cephalopoda bed. Some very fine specimens of *Rhynchonella tetrahedra* were obtained from the heaps of stone near at hand.

(To be continued.)

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from 217.)

II. *Pitch*, supposed to be discriminated by the responsive vibration of the rods of Corti, signifies the acuteness or graveness of the sound as determined by the ear; and is resolvable into the rate of vibration of the sounding body.

Dr. Wollaston considers that the degree of tension of the tympanic membrane affects our sensibility to pitch, and he thus explains the functions of the tympanic muscles. The *Tensor tympani*, which is inserted in the upper part of the handle of the malleus, by its contraction tightens the membrane; the *Laxator tympani*, inserted in the processus gracilis of the malleus, is supposed by some to assist in relaxing the membrane upon the remission of the action of the tensor; and the *Stapedius*, attached to a loop in the neck of the stapes, is supposed to govern the contact of this bone with the membrane of the oval foramen,—the tensor tympani concurring with it to tighten the membrane. From his experiments upon the effects of tension of the tympanic membrane, Dr. Wollaston concludes that a tense state of the membrane deadens its susceptibility to the effect of intense and grave sounds, as the firing of cannon, the rumbling of carriages over a bridge, &c., whilst it increases susceptibility to shrill sounds. The action of the muscles would seem to be in a measure voluntary, coming into play in the acts of listening and of preparing the ear to resist loud sounds,—in which condition I fancy I can myself detect a feeling of tension in my ear—though they must be largely reflex, called into action by the intensity of the sound itself.

One may render tense his own tympanic membrane by a strong continued effort of expiration or inspiration, keeping the mouth and nostrils closed—in the one case forcing air into the tympanum, tending to make the membrane convex towards the external meatus, and in the other case extracting air and making it convex towards the interior—in either case producing temporary dulness of hearing.

The gravest sound audible to the human ear is (according to Helmholtz) produced by 16 vibrations a second, the highest audible sound corresponding to 38,000, or, according to some, 50,000 vibrations a second—one of the deepest tones in use on orchestra instruments is the E of the double bass, giving 41½ vibrations a second, and the highest, the D of the piccolo flute, is 4,752. The practical range is thus about seven octaves; at the upper limit of hearing persons differ as much as two octaves; the squeak of a bat and the sound of a cricket are unheard by some ears.

A sound of uniform pitch is a musical note, the fact of uniform continuance inducing a pleasure of the nature of harmony.

The pleasurable and other effects of music open out a field much too wide for our present consideration. Spencer holds that the characteristic depth and vagueness of the sentiments awakened by musical tones are due to myriads of associations with the voice, vocal cries having been the commonest mode of expressing emotion through the various stages of animal development; whilst Darwin referred this phenomenon more especially to associations of vocal sound and deep sexual emotion built up during the courtships of unnumbered species; but we must leave this interesting subject for treatment by others.

Irregular vibrations produce simply noises, the perception of which some consider to be mainly due to the irregular irritation of the nerves by the otoliths. Although in music less intervals than a semitone are not admitted, the ear can distinguish still smaller differences. A quarter tone makes a marked difference to an ordinary ear, whilst a good musician can distinguish two tones whose vibrations are as 1,149 to 1,145, sounded after each other, and even a smaller difference if they are sounded together. Two pitchforks, whose number of vibrations per second are 1,209 and 1,210, sounded simultaneously can be distinguished by a first-rate ear.

The concurrence of two or more sounds may be pleasing or displeasing, irrespective of their individual character. The pleasurable concurrence is called *harmony*. It is dependent upon the numerical vibrations of the two sounds. Simple ratios as 1 to 2 (octave), 2 to 3 (fifth), 3 to 4 (fourth), 4 to 5 (major third), 5 to 6 (minor third), are harmonious in the order stated. All these are admissible in musical composition, and are termed *chords*. The combination 8 to 9 (a single tone). is a *dissonant* combination; 15 to 16 (a semitone) is a *grating discord*. In the lowest audible notes, as in a very deep organ note, the auditory sensation tends to lose itself in the tactual and organic sensations due to the vibration of the air, floor, &c. The *duration of an impression of sound* would appear, from the experiments of Savart, to be less than one-tenth of a second, since a series of beats begins to be felt as continuous when it numbers ten to twelve per second.

III.—*Quality*, *timbre*, or *klang*, is explained by Helmholtz by the presence of auxiliary *upper tones*, *e.g.*, it is found that a note sung by the human voice, or struck on a violin, is much fuller and finer in quality than one uttered by a flute, and this difference exactly corresponds to the variation in the number of the upper tones present. When the note is nearly destitute of upper tones, as in the case of a stopped organ pipe, it is thin and poor, and does not minister to the proper enjoyment of klang. He also states that the difference in the vowel sounds is due to the nature of the upper tones associated with the ground tones, *e.g.*—

In *u* (f*u*ll) the ground tone is heard alone;
,, *o* (*o*h) the next octave is audibly combined with the ground tone;
,, *e* (g*e*t) the ground tone is strongly mingled with the second octave above;
,, *i* (b*i*t) the ground tone is weaker, and the second and fourth octaves above strong;
,, *a* (*a*h) the ground tone is modified by the marked presence of the fifth, sixth, and seventh octaves above.

He applies a similar principle to explain differences in the consonant sounds; but in these the distinctions are generally so palpable that the different shocks they cause to the nerve of hearing seem generally a sufficient explanation.

The theory of Helmholtz may be summarised thus:—

I.—That what appears to us to be a simple sensation of tone is a composite mass of sensations resulting from a fusion of a ground tone and several feebler upper tones, each of these elements being transmitted by a distinct nerve fibre, and that each individual tone is itself the produce of hundreds or even thousands of vibrations, each probably causing some physical change in the nerve of hearing, though not sufficiently intense to rise into consciousness.

II.—The harmony of two tones is referred to the purely negative condition of non-disturbance between the prominent upper tones of the two notes—or that harmony arises from the union of two masses of tone, each of which affects a plurality of nerve fibres, and the elements of which are in no case so near to one another as to produce intermittent shocks of tone. That is to say, that just as a single musical clang is demonstrated to be an enormously complex product, so harmony is proved to be a more complex product of this product; and *finally*, that the pure pleasure of *melody* arises from the presence in sequent clangs of some common tonic element which serves to bind them together by a simple bond of sensuous resemblance.

Auditory spectra or *subjective sounds* such as singing, buzzing, ticking, snapping, humming, &c., accompanying overwork and disease, the noise persisting after reviews, railway, coach, or steamship travelling, &c., arise from disease of the brain or nerve, pressure of congested blood vessels upon the auditory nerve, over-stimulation of the nerve, inducing a temporary morbid condition, obstructions in the tympanum, Eustachian tube, &c., and seem to prove conclusively that *sound* (like other sensations) *is essentially a state of a special nerve* (here the auditory) excited externally or otherwise. The interference with hearing caused by bodily affections, as diseases of the abdominal viscera, and febrile affections, may be largely caused by the sympathetic affection of the auditory nerve, though they frequently depend upon partial or complete occlusion of the Eustachian tube and external meatus by the congestion of their walls or surroundings.

(To be continued.)

A FUNGUS PHANTASY.

Vertumnus speaks:—

This is the fated day when toadstools grim,
And harmless mushrooms, in sad livery dim,
Meet on October's brown and sodden banks,
Exchange their confidences and re-tell,
In murmurs husky, what to each befell,
Since last the Woolhope thinned their gathering ranks.

"Oh! a merry, merry crew are we,
What pranks on the men we play!
Bacillus the slim, Bacterium stout,
Staid Coccus, and Vibrio gay.

In France and in Spain we have been,
And revelled 'neath Italy's skies;
We compass the world with our terrible band,
And hide in most varied disguise."

"Wilt list to the lay of a Myxomycete?
A fungus primordial I;
Of race undefined, half-animal still,
To class me in vain you may try.

Not even a Zopf the enigma can read,
Nor De Bary my lineage tell;
So gruff Rostafinski the riddle has shirked,
And Sachs has been puzzled as well."

"Petted and *cultured*, a glorious fate,
Ours is a destiny certainly great.
Specialist, amateur, all hold us dear,
Only the farmer and gardener fear.

Neatest of all, on leaves living we riot,
Not, as the mob, confined to one diet;
We travel in state, and enjoyment derive,
Though our *hosts* be reluctant, we fatten and thrive."

"Ah! behold us, slighted beings;
Moulds both blue and green and red,
White and olive, brown and golden,
Scarcely dare to raise the head."

"We come, the *élite*, the *crême de la crême*,
For the lords of the Fungi make way!
The tough Hallimasch, Lamb's Kidney, Earth-star,
Coprinus that fades in a day,

The Fairy Champignon, in fable renowned,
The Oyster, the meek Chantarelle,
The nutty Bolétus, the juicy Beef-steak,
Rare Truffle, and fragrant Morell.

Then bring Witches' butter, and Cyathus' eggs;
We'll *cooke* you an omelet dainty and nice—
So dainty, no *fillips* your appetite needs,
'Twill *plow right* to the core of your heart in a trice.

Peziza herself shall the goblets provide,
Theléphora cover the board,
The Royal Agáric preside at the feast,
And on ketchup get drunk as a lord."

Talk ended, "Let's finish our pleasant *séance*
With a grand pyrotechnic display,"
Said young Gunpowder Sphæria, proud of his name,
And the Puff-ball inclined the same way.

Then faint phosphorescing, from mouldering trees,
Rhizomorpha illumines the gloom;
The balloons of Sphæróbolus rise in the air,
And the guns of Pilóbolus boom.

Hush! silence descends; the pale yellow moon
Peeps peacefully over the hill.
No more Peronóspora waves in the breeze,
And the quaking Tremella is still.

GAMMA.

October 1st.

ANTHROPOLOGY, ITS MEANING AND AIM.*

BY JOSEPH SMITH, JUN., M.A.I.

The progress which has within the last fifty years been made in the investigation of those matters which trench on the borders of recognised science, or form great factors in the establishing of presumed science on a firm basis, is one which must prove of the utmost importance to those interested in the advance and development of science and scientific undertakings.

* Read at a meeting of the Warrington Field Club, Feb. 6, 1885.

In the earlier days those interested in many—more correctly speaking—in most of these scientific experiments did not, however, meet with the encouragement their labours demanded nor receive the honour merited. Geology only comparatively late has become recognised as a science, and as such established; while Mesmerism or Animal Psychology only within recent years begins to receive the attention a new science ought to demand. The supporters of every branch of scientific study have had to encounter these difficulties, brought about by opposing and contending principles. Astronomy even, by whose laws the heavenly bodies are traced in their courses, each one separate, yet all performing a part in one harmonious whole, had its advance staggered, checked, and opposed by the introduction of theories propounded for the purpose of proving such laws untenable. So also the science of Anthropology has only recently been put forward to its place in the scientific cycle.

Anthropology, the study of man, derived from the Greek words ἀνθρωπος, "man," and λογος, "discourse," signifying a discourse on man, may be more correctly defined as "a promotion of the study of the science of mankind, by an accumulation of observations bearing on man's past history, and his present state in all parts of the globe." One of the greatest difficulties indeed is the multifarious features that the study embraces, and that range themselves under this branch of knowledge. One of the chief factors of Anthropology is Ethnology. This may be taken as the earlier title of the study under consideration. It had, however, a far more limited and definite line of research, yet it was regarded as a whole, complete in itself, and so far as it went, embraced all that was then required; for the knowledge of the bearings of Anthropology was then limited, but under the development of this science we find it falling into a place, and assuming a very important factor in the study of man. Ethnology, likewise derived from the Greek words ἐθνος, "a nation," and λογος, "discourse," embraces the study of the various peoples or races which form the population of the globe, with their physical and moral development, languages, social customs, opinions, beliefs, origin, history, migrations, present geographical distribution, and relative position to each other. The study of Ethnology is two-fold. Firstly, by considering the laws which have determined and regulated these characteristic features, which is therefore called "general Ethnology;" and secondly "by a study, comparison, and description of the races themselves as distinguished from each other by the special manifestations of these characters in them," which is embraced by the term "special Ethnology or Ethnography." Such is the definition of this interesting branch of the science as submitted by one of the leading anthropologists of the day. As now understood, however, Anthropology treats of man as a whole, and in doing so draws for assistance on the allied sciences—zoology, comparative anatomy, physiology—in order to demonstrate more concisely the development of the masterpiece of the Creator's handiwork. His origin also comes in for an amount of investigation. This enquiry immediately suggests to the student the great questions—whether man is a new-comer on the earth or an old inhabitant,—what his relation to the rest of the universe,—whether all races are different and have appeared as we now find them, or have assumed their present state and form through a long series of ages.

Now, in examining questions so intricate and important, the wider the range of knowledge which can be brought to bear on the matter, and the greater the comparison offered, the less risk there is of error in distinguishing, and assigning to man, his correct position amongst his zoological allies. Moreover, the position and place held by man in the zoological cycle is not the only point which has to be established, but also the development of his moral and intellectual faculties; and Psychology, which is now demanding from scientists so much attention and investigation, must be embraced as another important factor in a complete system of Anthropology. Again, Geology has to be called in to render its quantum of light, and enables the enquirer to fix the age of the strata in which man's remains have been found, and the position he held in those early times, and consequently provides some chronological data as to the age of man; but in tracing the origin and progress of man from his primitive condition the characteristic resemblance to the lower animals is quickly left behind, and, says Professor Flower, "It is on evidence of a kind peculiar to the human species, by which man is pre-eminently distinguished from all living beings, that our conclusions exist." The knowledge we gain of man in the earlier period of his existence by the assistance of prehistoric archæology, helps us in the investigation of all human culture, and assists us in tracing back to their origin, the arts, customs, and manners of man. Yet in following an argument on these lines, the difficulty crops up as to what must be included, and what must be excluded, as though the term *prehistoric* marks the boundary between the historian and anthropologist, yet it is perfectly evident that the one unconsciously lapses into the other.

The foregoing, if I may be allowed the term, may be taken as an epitome or definition of the science of Anthropology, and will serve as a fitting introduction to a few remarks on that subject, to the study of which in all its features Anthropology devotes itself, viz., man. At the very outset it will be asked "What is man? Define this being or animal called Man." He has been styled "An Intelligence assisted by organs." Such was the definition of a very profound thinker, Cardinal de Bonald, and this would be a very exact definition could it be exclusively applied to man, since it reflects his great characteristic feature, intelligence; but animals may be regarded as "*Intelligences assisted by organs*,"—they, too, possess an intelligence which prompts them in their necessities, but although man is an animal covered by an envelope which is common to all mammalia, yet he is superior to, and far surpasses, the lower creatures in intelligence and perfection of bodily formation. Figuier, a naturalist of the French school, defines man as "An organised intelligent being endowed with the faculty of abstraction" ("Human Race," p. 1); and another writer* styles him the noblest of all earthly creatures, standing related on the one hand through his body to the world of matter, on the other through his mind to the world of spirit, or nether world; at the verge of the animal kingdom most remote from its point of contact with the kingdom of organic (?) life, yet an inhabitant of such other kingdom *of pure intelligence*. The above may be accepted as the most perfect definition of man, but as such are merely expressions of theory, and on that account liable to rejection, a perfectly accurate definition cannot be given, since that would presuppose a perfect knowledge, of which our understanding on this question of man is incapable.

The origin of man, or the genesis of species, so far as it relates to man, becomes then one of the most interesting points which can entertain our powers of observation and investigation. Opposing scientific views and religious beliefs, and the conceptions of opposite philosophers, by a continual and increasing conflict, tend to evolve a comprehensive view of the origin of species, which will eventually harmonise them with one another; and when this comes to be finally established it will be one of the greatest benefits which can possibly be bestowed, as diverting the energy so often expended in useless controversy into a profitable and reciprocal channel, of mutual benefit to all. In the theory of the

* "Man," in Encyclopædia Brit.

"Evolution of Man," as set forth by the author of the "Origin of Species," although it may have points of question at the present moment trenchant thereon, there is nothing which can eventually make it antagonistic to sound Christian theology. The evolution theory has during these later times been making a steady progress and gaining ground. Within the next few years, there is not the slightest doubt, the facts touching on this august question will be greatly augmented. The points at issue will be reconciled, and those now deemed untenable will not improbably find further evidence to support them, the results of which will be to firmly fix this theory, as I have previously noted, on a basis at once compatible with scientific belief and sound Christian theology.

Amongst the principles of evolution we find one enunciating that every individual has to undergo a severe struggle for existence, owing to the tendency to a geometrical rate of increase of all kinds of animals and plants, the consequence of which is that every variation of a kind tending to save the life of the individual possessing it, or enabling it more surely to propagate its kind, will eventually be preserved, and will transmit its peculiarity to the offspring; which peculiarity will, in its transmission, become more intensified until it arrives at the maximum degree of utility. (See Mivart's "Genesis of Species," pp. 5-6.)

In this proposition we have a line to follow in our search for the "Origin of man," and there does not appear any great difficulty in arriving at the conclusion of the evolving of man from an inferior creature. The writer of the "Origin of Species" speaks of "life with its several powers having been originally breathed by the Creator into a few forms or ova,"* and it must be conceded that Creation is not what many who are ignorant of the effect of natural laws regard it, a series of cataclysms and miraculous interferences with the laws of Nature, during which some new form of life is belched into existence, but the very institution and working of those laws; for law and regularity, not arbitrary intervention, was the true patristic ideal of Nature. Hence, as Creation is the progress and fulfilment of the laws of Nature in the course laid down by the Creator, and the law of evolution leads to the existence of the fittest, it may be assumed that the Creator having the great object —the creation of man—in view from the beginning, ordains that these laws of Nature, so set in motion by His omnipotent

* "Origin of Species," Fifth Edition, 1869, p. 579.

power and omniscient will, shall act in such manner as to evolve and perfect from the lower creations a being whose progression to perfection shall be in such a delicate gradient, that it shall be impossible for the human understanding to point out where the animal ceases and man begins.

(To be continued.)

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 268.)

CRYPTOGAMIA.

ACOTYLEDONS.

FILICES.

PTERIS.

P. aquilina, *Linn.* *Brake or Bracken.*
Native: On heaths, hedge banks, and woods. Very common. June, July. Area general.

LOMARIA.

L. spicant, *Desv.* *Hard Fern.*
Native: In woods and on damp banks. Local.

I. In lanes about Aston Park, *With.*, *Ed.* iv., 750 (extinct); Coleshill Bog! *Ick. Anal.*, 1837; Sutton Park; Trickley Coppice; New Park and other Middleton woods; Bentley Park; Hartshill Hayes; Coleshill Heath; Marston Green; woods near Solihull; Olton Reservoir; Monk's Path, near Shirley; Windmill Naps, Little Ladbrook.

II. Heathy places on Honiley Common! *Baynes*; Haseley Common, *Perry*, *Phyt.* i., 510; Stoke Heath Woods, *T. K.*, *Phyt.* ii., 810; Fern Hill! *Y. and B.*; near Wolston Heath, *H. W. T.*, *R. S. R.*, 1874; very fine and abundant in Haywoods.

ASPLENIUM.

A. Ruta-muraria, *Linn.* *Rue-leaved Spleenwort.*
Native: On old walls and ruins. Local. June to October.

I. Aston Park Wall! *Ick. Anal.*, 1837; Bickenhill Church! Maxtoke Castle! *W. T. Bree*, *Phyt.* i., 511; ruins of Nuneaton Abbey! *T. K.*, *Phyt.* ii., 810; old walls about Dosthill; old walls, Ansley; near Curdworth Bridge; Water Orton Bridge; bridge near Castle Bromwich; bridge at Elmdon; old walls, Mancetter abundant; old walls, Wilnecote, near Tamworth.

II. Church porch at Great Alne; Walcot; Wixford, *Purt.* ii., 513; Tachbrook and Kenilworth Churches, *Perry Fl.* 84; Allesley; Stoneleigh, *W. T. Bree;* Southam Church! *W. W. Baynes;* St. Mary's Church-yard Wall, Warwick, *W. G. Perry;* Tachbrook Church; *Murcott;* Vicarage and Priory Walls, Warwick; Coventry Town Wall, *J. S. Baly, Phyt.* i., 511; on wall of park at Watford, *L. C., R. S. R.,* 1874; walls, Wootton Wawen, abundant; bridge near Shrewley Canal Tunnel; bridge, Atherstone-on-Stour.

A. Trichomanes, *Linn. Common Spleenwort.*

Native: On old walls and ruins. Rare. June to October.

I. Elmdon Hall, near Hockley, *W. Southall, Phyt.* ii., 511; Maxtoke Priory; Coleshill; bridge over the River Cole, near Coleshill; near Knowle; railway bridge near Solihull; old bridge, near Mancetter.

II. On Coughton Church; Walcot, *Purt.* ii., 514; walls at Kenilworth Castle, *Perry Fl.,* 84; Allesley; Stoneleigh, *W. T. Bree;* church porch, Stratford-on-Avon, *W. G. Perry;* Newbold, *R.S.R.,* 1880; bridge over the Avon, Stratford-on-Abon, *J. Humphreys.*

A. Adiantum-nigrum, *Linn. Black Spleenwort.*

Native: On old walls and dry shady banks. Rare. April to October.

I. Maxtoke Priory, *J. S. Baly, Phyt.,* ii., 511; Meriden, Balsall, *Bree, Phyt.,* i., 511; in a lane near Berkswell; lane between Meriden and Hollyberry End, *Kirk, Phyt.,* ii., 810; marly banks, near Knowle; Damson Lane, Solihull.

II. Sambourne; Middletown; Oversley, *Purt.,* ii., 512; walls at Kenilworth Castle; stone quarry, Coton End, Warwick; on Emscote Bridge, *Perry Fl.,* 84; common in the parish of Corley; Allesley, *W. T. Bree;* rocky bank below Milverton, *Baynes;* between Hampton-on-the-Hill and Norton Lindsay; Fen End, *Perry;* on a bank near Henley; on the church at Henley, *Murcott;* Norton Hill, *Baly, Phyt.,* ii., 511; on a bridge at Binley, *Kirk, Phyt.,* ii., 809; in a ditch near the Blue Boar; on old walls near Little Lawford Mill, *R. S. R.,* 1874; old walls in the village of Haslor; on old bridge near Henley-in-Arden.

ATHYRIUM.

A. Filix-fœmina, *Bernh. Lady Fern.*

Native: Near streams, ditches, and in damp woods, copses and other damp places. Locally abundant. June to September.

I. Coleshill, *Bree, Purt.,* iii., 79; Bannersley Common and Wood! moist bank near to Stonebridge! *Murcott;* in a lane near Sutton Park, *Cameron, Phyt.,* i., 511; Sutton Park; Middleton Heath; Trickley Coppice; New Park and Middleton Park; Marston Geeen; near Knowle and Solihull; Bentley Park; Poors Wood and Blackhill Wood, Honiley.

II. Allesley, *Bree, Purt.,* iii., 79; between Leamington and Kenilworth! *Baynes;* on the porch of the church, Stratford-on-Avon, *Perry, Phyt.,* i., 511; Oversley Wood; Haywoods, &c.

Var. *rhæticum,* Roth.

I. Sutton Park; near Ashfurlong House; Trickley Coppice; New Park; Marston Green; Meriden Shafts; Hartshill Hayes; Bentley Park; Blackhill Wood, Honiley.

II. Boggy places, near Binley; Stoke Heath; Deer Park, Arbury, *T. Kirk, Phyt.,* ii., 809; Fern Hill! *Y. and B.;* Haywoods.

Var. ***molle,*** **Roth.**

II. Arbury Deer Park, *T. Kirk, Phyt.*, ii., 809 ; Haywoods, 1871.

The varieties of this species have not been sufficiently noticed to allow me to assign each variety to its particular locality. I have only localised the varieties where special notice of them has been recorded by other observers, or where special notice of them occurs in my own note-book.

Var. *incisum*. Crackley Wood, *Y. and B.*

CETERACH.

C. officinarum, *Willd.* *Scaly Spleenwort.*

Alien : On old walls near gardens. Very rare. May.

I. On old walls, near Atherstone, *G. T. Harris !*

II. Walcot, in Haslor parish, *Purt.*, ii., 517 ; on a brick wall at the back of the mansion house, Tachbrook, *Perry*, *Phyt.*, i., 511 ; Wall of Lancastrian Yard, Coventry, *Kirk*, *Phyt.*, ii., 809 ; old wall, near Birdingbury Hall, *H.B.*

SCOLOPENDRIUM.

S. vulgare, *Syme.* *Hart's Tongue.*

Native: On damp shady and marly banks and old walls. Rare. June to August.

I. Knowle! *W. Southall ;* damp shady places near Elmdon, *D. Cameron ;* boggy ground near Solihull, *Mr. Ick*, *Phyt.* i., 511 ; damp banks, Marston Green ; near Hampton-in-Arden ; on an old bridge near Knowle.

II. In a ditch by the side of the footpath from Warwick to Hampton-on-the-Hill, *Perry Fl.* 85 ; plentiful at Hatton Rock, near Stratford ; Kenilworth, near the ruins ; bank of a pool at the Woodloes ; roadside between Budbrook and Hampton-on-the-Hill, *Murcott ;* Tachbrook, *Baly*, *Phyt.* i., 511 ; in Princethorpe village, *Blox. M.S. note ;* Lighthorn village, *H.B.;* on marly and damp banks near Claverdon ; and near Holywell.

Formerly abundant in many of these localities, but now eradicated in most of them.

CYSTOPTERIS.

C. fragilis, *Bernh.* *Brittle Bladder Fern.*

Alien : On old walls. Very rare. June to August.

II. Near Arbury Hall, *T. Kirk*, *Phyt.* ii., 972 ; Guy's Cliff, near Warwick! *T. F. Foster, jun.*, *Herb. Brit. Mus.*, 1849 ; near Guy's Cave, Guy's Cliff, 1877, an escape probably ; Compton Verney, *D. Cameron*, *Phyt.* i., 510.

ASPIDIUM.

A. aculeatum, *Sw.* *Common Prickly Shield Fern.*

Native : on hedge banks. Local. June to September.

I. In a ditch near Elmdon, *With.*, ed. 4, 761. Abundant near New Park, Middleton ; Middleton Heath ; banks, near Nether Whitacre, Shustoke, and Maxtoke ; Islington, near Kingsbury ; banks near Hartshill and Arley ; banks near Fillongley and Meriden Shafts ; banks near Knowle and Solihull ; lanes near Baddesley Ensor.

II. Pinley! Rowington! *Y. and B.*; near Barby; Blue Boar Lane; roadside between Long Lawford and Little Lawford Mill! *R. S. R.* 1877; Dilke's Lane, near Kingswood; Lapworth, Holywell, Claverdon, &c.

b. lobatum.

I. Saltley, *Ick*, *Anal.*, 1837; near Packington, *Smith*, *Perry Fl.*, 83; Elmdon! and near Castle Bromwich, *Cameron*: near Maxtoke! *Luxford*, *Phyt.*, i., 510; Four Oaks, near Sutton; Middleton Heath; lane near Islington and Baddesley Ensor; lanes near Arley; lanes near Shustoke.

II. In a wet lane at Studley; Sambourne; Oversley! *Purt.*, ii., 509. About Warwick, *Perry Fl.*, 83; thicket between Huningham and Offchurch; on the road from Warwick to Henley, *Murcott*; Allesley! *Baly*, *Phyt.*, i., 510; Pinley! *Y. and B.*; Hampton-on-the-Hill, *H. B.*; Stoneleigh; Hollyberry End! Wyken Lane! *T. Kirk*, *Phyt.*, ii., 809; near Kingswood.

c. lonchitidioides.

II. Near Stoneleigh; Meriden, *Kirk*, *Phyt.*, ii., 809: near Hatton! *H. B.* Merely an abnormal growth.

A. angulare, *Willd.* *Angular-lobed Shield Fern.*

Native: On hedge banks. Local. June to September.

I. Elmdon! and near Castle Bromwich, *Cameron*, *Phyt.* i., 510; Middleton Heath; near Fillongley and Maxtoke; near Meriden Shafts; Bentley Heath, near Solihull.

II. Rare near Warwick, *Perry*; Radford; ditch at the top of Emscote Hill, opposite the turn to Milverton, *Baly*, *Phyt.* i., 510; near Stoneleigh; near Berkswell! Hollyberry End! Stivichall; Whitmore Park; Hearsal Common, *Kirk* *Phyt.* ii., 809; near Hawkes End, Allesley.

NEPHRODIUM.

N. Filix-mas, *Rich.* *Male Fern.*

Native: On hedge banks, in woods, and bushy places. Common as an aggregate species. June to August. Area general.

b. affine, Fisch. Local.

I. Trickley Coppice; New Park; Middleton Heath; Austrey, near Tamworth; Shustoke; Hill Bickenhill; lane near Meriden Shafts; Hazel Hill Wood, Honiley; &c.

II. Bearley and Snitterfield Bushes; Austey Wood; Wootton Wawen; Oversley Wood; Old Park Wood, Ragley, &c.

c. Borreri, Newm. Local.

I. Middleton Heath; Trickley Coppice; New Park; Hill Bickenhill; Great Packington; lane near Fillongley and Maxtoke; Black Hill Wood, Honiley.

II. All Oaks Wood, Cathiron Lane, Brinklow.

d. abbreviatum, DC. Very rare.

II. Oversley Wood.

N. spinulosum, *Desv.* *Narrow Prickly-toothed Fern.*

Native: On damp banks and in damp or marshy woods and copses. Local. June to August.

I. Coleshill Heath! Frogmore Coppice, near Temple Balsall, *Murcott*, *Phyt.*, i., 510; Sutton Park; Trickley Coppice and New Park, Middleton; Kingsbury Wood; Bentley Park; Hartshill Hayes; Arley Wood; Bannersley Rough; marsh near Packington; copses in Wheyporridge Lane, Solihull; Shelly Coppice; woods near Sharman's Cross; Blackhill Wood, Honiley; Windmill Naps, Little Ladbrook.

II. Allesley, *Bree*, *Purt.*, iii., 81; Chesterton Wood, *Perry;* Waverley Wood, near Weston, *Murcott*, *Phyt.*, i., 510; Haywood! *Y. and B.* In boggy places near Binley; North Wood, Arbury Hall! *Kirk*, *Phyt.*, ii., 807: near Rugby, *A. Blox.*, *Herb. Brit. Mus.* Oversley Wood; Newlands Wood, Hatton; Plants Hill Wood, near Tile Hill; Austey Wood, near Henley-in-Arden; Bearley, and Snitterfield Bushes.

N. dilatatum, *Desv.* *Broad Prickly-toothed Fern.*

Native: In woods and copses, and on banks. Locally common. June to August.

I. Sutton Park; Middleton Heath; Trickley Coppice; New Park; Bentley Park; Hartshill Hayes; Bannersley Pool and Rough; woods about Solihull; banks near Knowle and Hockley; Hazel Hill Wood, Honiley; Windmill Naps, Little Ladbrook.

II. Coughton Lane and Spernall, *Purt.;* Allesley, *Bree*, *Purt.* iii., 80; Oakley Wood; rocks below Milverton, by the Avon, *Baynes;* Woodloes, *Perry;* Foleshill, *Baly*, *Phyt.* i., 510; Stoke Heath, sparingly! Stivichall, Whitly Common; plentiful and very fine North and other woods in Arbury Park! *Kirk*, *Phyt.* ii., 809; Lower Hillmorton Road, Blue Boar Lane! lane near Bilton, *R. S. R.*, 1877; Honiley; Fernhill! *Y. and B.;* Oversley Wood; Bearley Bushes; Haywoods; woods near Tile Hill; Combe Woods.

N. Thelypteris, *Desv.*

Native: In marshes and bogs. Very rare. July, August.

I. Sutton Park.

II. In a boggy pit, Allesley, *Bree. Mag. Nat. Hist.* iii., 166; in a pit near Rounsell Lane, Kenilworth, *H.B.;* I believe exterminated in both localities now.

N. Oreopteris, *Desv.* *Sweet Mountain Fern.*

Native: In woods, copses, on banks, and near streams. Rare. June to September.

I. Coleshill Heath, plentiful! *Bree. Phyt.* i., 510, rare in this locality now; in a lane near the Bell Lane at Erdington, *With.*, *Ed.* 7, 995; near Atherstone, abundant, *G. J. Harris;* Sutton Park, formerly abundant by many of the streams; Middleton Heath; Trickley Coppice, Middleton; Bannersley; Marston Green; Windmill Naps, Little Ladbrook.

II. Corley, *Bree. Purt.* ii., 508; Dunsmore Heath, near Rugby, *Doody in R. S.*, *Perry Fl.*, 83; Haseley Common, *Perry*, *Phyt.* i., 510.

(To be continued.)

Review.

Spectrum Analysis. By Dr. H. SCHELLEN; translated by JANE and CAROLINE LASSELL; edited by Capt. ABNEY. Second edition, 8vo., 626 pp., 14 plates, 291 woodcuts; price 31s. 6d. Publishers, Longman and Co.

ALL students of science will welcome this new edition of Dr. Schellen's excellent book. It is divided into eight parts, treating respectively of the artificial sources of high degrees of heat and light; the application of spectrum analysis to terrestrial substances; to the examination of the sun; of the moon and fixed stars; nebulæ and star-clusters; comets and meteors; the zodiacal light, aurora borealis, and lightning. In the early chapters, the principles of light, the construction of the spectroscope, and the history of the discoveries which have been made by its aid are dealt with in the fullest and clearest manner. Throughout the book each chapter contains the latest reliable information on the subject of which it treats, and this is so put together, and the facts are so skilfully handled and massed, that the book, as a whole, is far more easy to understand than many an elementary text-book. The Misses Lassell have so translated the book that we cannot detect that it *is* a translation, while Capt. Abney's own researches in this subject have enabled him to render valuable aid as editor. The illustrations are extremely satisfactory, such, alas, as we only find in scientific books of foreign origin. The frontispiece, however, a Woodburytype reproduction of Mr. Common's magnificent photograph of the great nebula in Orion, we are proud to claim as of English origin throughout. As the most complete and exhaustive work on the subject, this book ought to be in every library. It does great credit to all who have been engaged in its production.

W. J. H.

METEOROLOGICAL NOTES.—August, 1885.

Atmospheric pressure was unsteady during the month, the barometer falling, with slight checks, to the 10th, when the reading was 29·563 inches. A rapid rise followed to the 15th, 30·350 inches, and unimportant fluctuations continued till the end of the month. Temperature was about four degrees below the average, lower in fact than that of any of the previous nine years, the deficiency being more especially noticeable in the maximum readings. The highest recorded were 78·5° at Henley-in-Arden, on the 17th; 76·0° at Loughborough, on the 25th; 74·8° at Hodsock, and 74·0° at Strelley, on the 16th. In the rays of the sun, 133·9° at Loughborough, on the 15th; 128·8° at Hodsock, on the 6th; and 125·0 at Strelley, on the 10th. The lowest minima were 35·0° at Henley-in-Arden, on the 14th; 36·3° at Hodsock, 36·6° at Strelley, and 37·9° at Loughborough, on the 15th. On the grass the mercury fell to 29·0° at Hodsock, 35·0° at Strelley, and 35·4° at Loughborough, also on the 15th. Rainfall was somewhat above the average, heavy showers being the principal factors in the total. The largest amounts measured were 0·78 inches at Loughborough, on the 21st; 0·66 at Hodsock, on the 7th; 0·56 at Henley-in-Arden, on the 12th, and 0·47 at Strelley, on the 6th. The total values were:— Henley-in-Arden, 2·90 inches; Loughborough, 2·83 inches; Hodsock, 2·58 inches; Strelley, 2·02 inches. The number of "rainy days" varied from 13 to 10. Sunshine was much below the average. Thunderstorms occurred at Loughborough on the 6th and 7th. There was every prospect of an early harvest, but field operations have been much retarded by the unsettled state of the weather.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

Death's Head Hawk Moth.—The larvæ of *Acherontia atropos* have occurred here (North Leicestershire) in some numbers during the last few weeks, the first seen for a number of years. The specimens found were scattered through this district in localities many miles apart. Nearly all were found feeding on the potato, but two were sent me from Leicester, which had been found feeding on the plant commonly called tea tree; and on the 5th September, I obtained one of three which were feeding on the privet, a food-plant not hitherto recorded, I believe, for the larva of atropos. Mr. J. B. Wieldt, F.Sc.S., informs me that till this year he has only seen one specimen here for fifteen years.—WILFRED MOSS, The White House, Loughborough.

THE WEAPONS OF BUTTERFLIES.—Having recently read a paper on "The Weapons of Animals," I was much interested this morning to observe how a butterfly is armed for the defence of his rights and the robbing of his neighbours. On the disk of a sunflower there sat a bumble bee, a hive bee, and two large flies (*diptera* apparently), all regaling themselves in peace and amity. A fine red admiral hovering by took a fancy to the same sunflower, and settled in the middle of it, flapping vigorously his great handsome wings. The bees and the flies edged away towards the margin, but he continued to flap till they were fairly driven off and he had the field to himself. Then he worked diligently over it, trying every floret with his long bent proboscis. The bees and the flies made several attempts to return, but as soon as they came within sight or touch, flap went the great wings, and away they flew as if they were frightened. The admiral kept the place entirely free from intruders for nearly five minutes, when he took himself off to "pastures new." F. T. MOTT.

AREGMA BULBOSUM.—It has occasionally been asked whether the above fungus is as common as Dr. Cooke reports it to be, for it has been carefully sought in this district for the last year or two with little success. At the present time it may be found abundantly in the neighbourhood of Bewdley, quite justifying Dr. Cooke's observation of "very common." I noticed that for the distance of perhaps a mile nearly every bush was more or less attacked by it. For the microscope this object mounts well in glycerine or balsam, and is very interesting. If any reader would like a leaf I shall be pleased to forward one on receipt of stamped envelope.—J. W. NEVILLE, Wellington Road, Handsworth.

[It is quite true that *Phragmidium bulbosum* scarcely merits the name of a "very common" species in this neighbourhood, for it is extremely local and irregular in its appearance, although where it does occur it is often in great abundance. The same is equally true, however, of most of the "common" species of leaf-fungi, not only for this neighbourhood, but, I believe, for many others. *Xenodochus carbonarius*, again, is a rare species, yet in the only locality near here where I have seen it (Water Orton), it grows in such great profusion that, both in 1883 and 1884, I could, if required, have gathered several thousands of affected plants. I have seen *P. bulbosum* in large quantities near Solihull, and near Kenilworth, besides other places; at the former place the bushes along the roadside for some distance appeared as if sprinkled with red paint, owing to the conspicuous blotches upon the leaves. This was in 1883. It is necessary, however, to state that the *Phragmidium bulbosum* of Cooke's works (*Aregma bulbosum* of the older editions, a name now obsolete) includes two species :—*P. violaceum* and *P. Rubi*, the distinguishing characters of which may be found in the "Midland Naturalist" for 1883, p. 21. It is of the former that I speak, *P. Rubi* being more rare here. I have seen no specimen of the latter from this neighbourhood. *Phragmidium obtusum* is the most common species, being always to be found by a little searching; *P. mucronatum* is more rare; and the rarest of all the Phragmidia of this district, so far as I know, is *P. gracile*, on the wild raspberry. On Saturday last (Sept. 19th) I saw several bushes attacked by *P. violaceum*, near Barnt Green Station.—W. B. Grove, B.A.]

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, September 1st, the President in the chair, Mr. W. B. Grove exhibited the following fungi:—*Hypocopra microspora* (new to England, previously recorded from Scotland, which has been hitherto the only known locality), and *Zignoëlla pulviscula*, from Edgbaston; *Leptosphæria Rusci* (on *Ruscus aculeatus* and on *R. Hypoglossum*) and *Leptothyrium Fragariæ*, from Sutton; *Trematosphæria pertusa*, from Barnt Green Reservoir; *Rhabdospora pleosporoides* (new to Great Britain) on stems of sorrel, taken from a nest of the common tern, which had been received by the President, Mr. R. W. Chase, from the West Wide Opens, one of the Farne Islands; mounted specimens of the spores of the Hypocopra and the Rhabdospora, for the microscope; also (on behalf of Mr. J. W. Oliver) a few plants sent by an old member, Mr. J. W. Pickering, from Victoria, Australia—two sundews, *Drosera Whitackeri*, and *D. glandulifera*, each about 1¼ inch in total height, and the former bearing one or more scapes, each with a single flower one inch across; and two orchids, *Caladenia deformis* and *C. pulcherrima* (spider plant). Mr. T. Bolton exhibited *Microcodon clavus*, a rare rotifer, from Coleshill Pool. Mr. J. Levick exhibited *Cordylophora lacustris*, from Hamstead Canal, and *Stephanoceros Eichhornii*, from Alvechurch. Miss Browett exhibited *Himanthalia lorea*, from the Brig, Filey. Mr. G. M. Iliff exhibited some excellent micro-photographs of Echinus spines. Biological Section, September 8th.—Mr. W. R. Hughes, F.L.S., in the chair.—Mr. W. H. Wilkinson exhibited ripe fruit of the Lawton blackberry, grown from plants received from America. A proliferous state of the white clover, *Trifolium repens*; a leaf 3ft. 6in. long of *Dimorphanthus mandghuricus*, one of the ivy tribe. Mr. J. E. Bagnall, A.L.S., *Carduus eriophorus*, woolly thistle; *Serratula tinctoria*, saw-wort; *Arctium majus*, great burdock; *Clematis Vitalba*, virgin's bower; *Chlora perfoliata*, yellow centuary; and other rare plants, and a fungus, *Panus torulosus*, new to South Warwickshire, all from the Stratford-on-Avon district.—General Meeting, September 15th. Mr. T. Bolton exhibited the spermatophores of the cuttle-fish, from Cornwall. Mr. W. B. Grove exhibited two eatable fungi:—(for Mr. C. E. Robinson) *Agaricus ostreatus*, the oyster mushroom, on a cherry log, from Legge Lane, Birmingham; and (for Mr. Edmonds) *Coprinus comatus*, from Hockley. Miss Taunton exhibited *Acanthus spinosus*, from Dorset, a plant whose leaf suggested the original idea of the Corinthian capital. Mr. W. R. Hughes exhibited (for Mr. C. Parsons) a specimen of *Sagartia* which showed the process known as spontaneous generation or "fissiparity," *i.e.*, two discs with mouths and tentacles appearing on a single column.—Geological Section, September 22nd. Mr. T. H. Waller in the chair. Mr. T. H. Waller exhibited sections of quartzite, from the Ercal Hill, Wrekin; basalt, from Shatterford, showing vein of orthoclase; Whinsill, from Holwick Scar, Teesdale. Mr. J. E. Bagnall, *Sparganium neglectum*, new to Warwickshire; for Mr. W. B. Stone, *Sedum album*, showing a remarkable instance of vitality, the plant having been gathered in leaf in April, at Lake Como, had been laid aside on study table, and had flowered and fruited after being pressed; *Hypnum scorpioides* and other mosses, from Dartmoor; for Mr. Hughes, *Echinops paniculata*, with notes on its structure; for Mr. Henry Groves, *Malaxis paludosa*, from Norfolk. Mr. Grove, a flower of Stapelia, a "carrion plant," so called on account of the carrion-like odour given off by the flowers. Mr. Herbert G. Young, *Colchicum autumnale*, from banks of River Tame, at Great Barr. Mr. James Simkins, Lias limestone, found in tunnel of West Suburban Railway between Church Road and New Street Station, containing *Ostrea Liassica*.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 24th.—Mr. Moore exhibited specimens of *Pupa umbilicata* var. *alba*, and *Helix rupestris* from the Isle of Man, also diminutive specimens of *Limnæa stagnalis*, three years old; Mr. Hawkes, the following fungi:—*Melampsora tremulæ* on Populus tremula, *Puccinia violarum*, and *Aregma mucronatum;* Mr. Dunn exhibited on behalf of Mr. J. Baxter a series of objects illustrating the life-history of the lady-bird, coccinella, comprising the egg, larva, pupa, and imago; also a specimen of musk beetle, *Aromia moschata*. A paper was then read by Mr. H. Insley on "Bye-paths in Geology." The writer regretted the too frequent habit of students of Natural History neglecting ordinary or commonplace facts, and proceeded to show the great neglect of physical facts in geology by the majority of students. The phenomena of unconformability, dislocation, and denudation were described, and their importance urged upon the attention of those studying the subject. Local examples were given, and their evidence regarding past conditions of the district dwelt upon. August 31st.—Mr. Deakin, scattered cluster cups, *Æcidium depauperans* on *Viola cornuta;* Mr. Madison, a distorted specimen of *Planorbis nautileus* (the whorls being divided) from Trimpley; Mr. J. A. Grew, pupa of death's head moth, *Acherontia atropos;* Mr. Tylar, an African water bottle made of a gourd; Mr. Mulliss, silicified wood from Australia. Under the microscope Mr. J. W. Neville showed *Aregma bulbosum;* Mr. Mulliss, eggs of house fly. September 5th.—An excursion was made to Rowley Regis at the invitation of the president (Mr. C. Beale), to view his collection of objects relating to pre-historic man, etc. The collection consisted of numerous specimens of Palæolithic and Neolithic implements, comprising celts and other implements in flint, basalt, and serpentine, from roughly chipped to highly polished specimens, some with oblique and faceted edges, from various parts of Europe, the grave mounds of America, and South Sea Islands; also some exceedingly fine specimens of spear and arrow heads in flint, jasper, and chalcedony, and obsidian, some having serrated edges, from the base of the Apennines. Bronze implements were represented by arrow heads, knives, etc., of the Etruscan period. Mr. Beale described the objects in their proper order, and through Etruscan pottery, Samian ware, and early English pottery (of which specimens were shown), linked the remote past with more recent times. A most instructive afternoon was spent. September 7th.—Mr. J. Madison exhibited specimens of *Gryphea biloba* from Cheltenham; Mr. Hawkes, the following fungi:—*Puccinia striola*, *P. menthæ*, *P. valantiæ*, and *Coleosporium campanulæ;* Mr. Rodgers, a small collection of butterflies and shells from Bournemouth. Under the microscopes Mr. Moore showed palates of *Ancylus fluviatilis* and *Zonites crystallinus;* Mr. J. W. Neville, leaf of *Pinguicula vulgaris* with insects; Mr. Hawkes, a species of Myxomycetes. September 14th.—Mr. C. P. Neville exhibited specimens of starfish from Wales;

Mr. Madison specimens of *Solen siliqua* and *S. ensis;* Mr. Hawkes, *Parnassia palustris;* Mr. Rodgers, an ichneumon fly, *Ophion luteum.* A paper was then read by Mr. W. Dunn on "Rotifers: their habits and habitats," in which he described a typical rotifer, and the views of early microscopists respecting them; the two kinds of rotifers—free swimming and fixed—the attachment of their eggs, their great fecundity, the general scarcity of males, and their modes of progression were severally dealt with, and types of the various kinds described. The paper, which was illustrated by diagrams, concluded by giving a few plain directions to their habitats, and the best modes of viewing them.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, Wednesday, September 16th. The Chairman reported that at the Field Day, on the 19th August, six members went to Brooksby Station, examined the River Wreake and the fields adjoining, and visited the prettily situated village of Hoby. In the river were found abundantly the water plants *Œnanthe fluviatilis, Potamogeton pectinatus, P. flabellatus, P. lucens, P. perfoliatus,* &c.; in the adjoining fields and on the river banks, *Tanacetum vulgare* and several other plants not hitherto recorded for that district. Also fifteen species of land and freshwater shells, including *Anodonta cygnea, A. anatina, Unio tumidus, Unio pictorum,* and *Dreissena polymorpha.* These five, the only species of large bivalves which inhabit the waters of the Midlands, were all taken together within one square yard. The Chairman proposed, as work for the Section during the autumn and winter, the preparation of a large number of drawings, magnified from three to twelve times, of the floral organs of various plants, both native and exotic. It would be a work of very considerable value and one in which the ladies could render great assistance. He presented a set of written instructions for the preparation of such drawings. Miss Catherine Hewitt was elected a member of the Section. Among the objects exhibited were some very fine specimens of *Anodonta* and *Unio*, dredged from the lake at Wistow Hall. one example of *A. cygnea* measuring six and a half inches in length; also specimens of the microscopic fungi, *Æcidium compositarum* and *Coleosporium tussilaginis*, on the leaves of the common colt's-foot, by Mr. Quilter. Several numbers of Cole's microscopic studies and slides, by Mr. Grundy. Fronds of the fern *Cystopteris bulbifera* bearing an abundance of its curious bulbils, by Mr. Thorp. Fruiting branch of *Rubus laciniatus*, the cut-leaved bramble, a variety which has been in cultivation for many years, being figured and described by Loudon in 1829, though rarely mentioned in more recent works, and which has lately been sold as an "American blackberry," by Miss Noble. A collection of thirty-five rare species of plants from Ben Lawers, by Mr. Carter, who promised a paper on the flora of that remarkable mountain. The fifteen species of shells collected by members of the Section at the last Field Day, cleaned and named; also a copy of Rimmer's "Land and Freshwater Shells of the British Isles," illustrated by photography, by the Chairman. The Chairman read a paper on "The Wild Geraniums of Leicestershire," explaining the distinguishing characters of the three genera, *Pelargonium, Geranium,* and *Erodium*; stating that out of about one hundred known species of *Geranium*, twelve were British, and that eight of these were found in Leicestershire, six being certainly indigenous. The paper was illustrated by dried specimens of all the British species.

SOME FACTS ABOUT ARUMS.

We are all familiar with the fact that plants absorb and decompose carbonic acid, and that while keeping the carbon to build up their tissues, they restore nearly the whole of the oxygen to the air for the benefit of the animal world.

All this is true, but it is not the whole truth. Some plants—the whole race of fungi for instance—breathe as animals do, and exhale carbonic acid; and the tiny yeast plant, as it multiplies in the wort, produces carbonic acid in such quantities that the gas may be seen flowing over the sides of the beer-vat. Nor is even this all. *All* plants take up oxygen and give off carbonic acid, and that at all hours of the day and night, but especially at night; though the quantity given off is so small compared with that which is absorbed that it is apt to escape notice. Whether performed on a large or small scale, however, this giving off of carbonic acid is true breathing; it means that carbon has been oxidised or burnt, and therefore that more or less heat must have been produced. Yet plants, like frogs, are, with certain exceptions, always cooler than the surrounding air, owing to the constant evaporation or perspiration going on through the myriads of minute pores with which their leaves are studded. There are 120,000 pores in a square inch of lilac leaf; some leaves have 800 to the square inch, others 170,000; and through these water is constantly being perspired as invisible vapour. A single sunflower plant has been known to perspire as much as twenty-two ounces of water in the course of twenty-four hours; and thus, although some small amount of carbon is always being oxidised, the leaves are kept cool. Plants are especially active in giving off carbonic acid at certain times—namely, when they first begin to sprout from seed and when they blossom; and when a number of seeds are all sprouting together, as in the preparation of malt, the heat is quite sufficient to be noticeable.

If the bud of some large flower, such as a thistle or cucumber, be isolated under a bell-glass, when just on the point of expanding, it will be found that its temperature rises from a half to a whole degree centigrade ($1\frac{4}{5}$° F.) In many blossoms the heat is much greater than this, and is like that from a stove or a feverish hand. It is especially noticeable in plants of the arum tribe. We all know the common white arum, or "arum lily" as some people call it, with its large glossy leaves and snow-white sheath or "spathe" surrounding the golden sceptre-like column, which botanists call the "spadix."

The true flowers are set round the base of this central column, what we call the blossom being in fact an assemblage of many blossoms, some of which are barren and some fertile. The fertile flowers bear pistils, and the barren stamens; and it is from the former, which are usually set lowest on the spadix, that the clusters of fruit are formed.

If the green sheath of the wild spotted arum or cuckoo-pint be wrapped in and filled with wadding to prevent the escape of the heat, the mercury in a thermometer placed close to the brown column will be found to rise several degrees.

The sudden increase of heat is more remarkable still in the heart-leaved arum of the Isle of Bourbon, whose temperature at blossoming time rises from twenty to twenty-four degrees centigrade above that of the surrounding air; and even this is outdone by the common Italian arum, which grows in the olive-yards, and is a familiar object to all who have enjoyed a Roman spring or spent a winter in the Riviera. This plant much resembles the cuckoo-pint, but its glossy dark leaves are larger and veined with yellow. The pale yellow sheath, which is stalkless, grows close to the ground, unfolds in March and April between 4 and 6 p.m., and emits a fragrant odour like that of wine, the temperature of the club-like column at the same time rising until it feels quite hot to the touch.

Professor Kraus found four of these arums near Rome one 28th of March, the temperature of whose blossoms varied from 40°C. to 43·7°C., that of the surrounding air being at the time 16°C.; 20°C. (68°F.) is a good summer heat, and 35°C. is blood heat, but these arum blossoms were hotter than a hot bath. This state of things did not last long, however, and by the following morning the sheaths had grown pale and wrinkled, the blossoms had passed their prime, and the heat had quite disappeared.

Interesting as these facts are in themselves, they become still more so when we consider them a little further, and ask what they mean. The older botanists, Humboldt included, had noticed the extraordinary degree of heat generated by some of the arum family, but there they stopped short, and the Italian, Delpino, seems to have been the first to suggest a reason for the phenomenon.

It is well known that in order to produce perfect seeds, most plants require to be fertilised by pollen brought from other plants of the same species. For this they are dependent upon wind, rain, birds, insects, &c., the two last mentioned being attracted to them by their bright colours or sweet scents.

Now the arum family are not deficient in these customary attractions, but they seem to try and outbid their neighbours by adding warmth to the list. Most arums, in the temperate zones at least, blossom early in the year, when the nights are still so chilly that a comfortable well-warmed bed is by no means to be despised; and accordingly the common Italian arum is visited by all sorts of small flies, gnats, and midges, bringing with them in payment for their night's lodging a tribute of pollen from their last quarters.

Many South European and foreign arums are flesh-coloured or reddish brown, and emit such a carrion-like odour that the flesh-flies are attracted and so far deceived as to lay their eggs on them. In these species the lower part of the sheath, which is enlarged like a bulb, is shut off from the upper part by a ring of longish hairs which slope downwards, and thus, while affording easy entrance to the warm chamber below, make the leaving of it again an impossibility.

In return for bringing pollen to the pistil-flowers, the flies are caught and kept prisoners; but not for long—only, in fact, until the anthers or pouches of the stamen-flowers above have burst and scattered their pollen, part of which naturally falls upon the captives, while part is brushed off by them when they are let out. For as soon as they have fulfilled their object, the hairs at once wither away and the insects come out to carry the pollen to other blossoms, quite undeterred by the fact of their imprisonment, for the prison is in truth a most luxurious one, well warmed and scented; besides, they have been fed with nectar from the faded pistil-flowers. The hairy arum of the South is, however, said to express her gratitude to her pollen-bringing visitors by keeping and devouring the greater number, which are sucked and digested by the acid juice exuding from the hairs with which her sheath is lined.

But there are other guests for which a number of the aröids seem especially to prepare their warm lodgings; these are the little marsh snails, which climb up the stalk and find entrance into the enlarged part of the sheath by a narrow aperture at its base, which closes later on. Aröids all like a damp situation, and growing as they do in shady woods, on river banks, and in marshes, no creatures could be better adapted for rendering them the services they need than snails, whose tastes in this respect are so very similar to their own. Most of those observed by Delpino were visited by small snails, and we may reasonably suppose that the foreign varieties are equally attractive to the race in their own lands.

One of the greenhouse aröids, *Philodendrum bipinnatifidum*, is a plant with handsome foliage, the leaves being deeply and doubly cut. Its sheath, which is greenish without and white within, swells into a cauldron-shape at the bottom, and in this cauldron is contained the ring of female or pistilliferous flowers, which, as in other species, are the first to open. In a specimen carefully watched by Dr. F. Ludwig, these flowers began to expand at noon, and at the same time the temperature of the air within the sheath began to rise and continued to do so until seven p.m. When the thermometer marked 38°C., and the heat was so great that it could be distinctly felt by the hand even at some distance, the temperature of the surrounding air was at this time only 15°C. As the flowers burst open a strong, fragrant scent, something between musk and cinnamon, filled the whole house; and this, in the plant's own country, would no doubt be well understood by the snails as a signal that their bed-chamber was comfortably heated and ready for their reception. By noon the following day both heat and fragrance were much diminished, and the aperture at the base of the sheath was entirely closed. When this closed, and not till then, the anthers of the upper ring of blossoms burst open and discharged their pollen, which hung about the spadix in tassel-like threads an inch long, instead of separating into dust in the more usual manner.

Now insects could not possibly carry these tassels, but they would adhere readily to the moist bodies of snails, and in contact with them would be broken up into single grains and thus easily carried away. And the snails must crawl up the sheath and come in contact with the pollen, because the door by which they entered at the bottom is now closed. Go they must, moreover, for their hostess has burnt carbon so liberally through the night that the cauldron is filled with carbonic acid, and they would be suffocated just as surely as the glowing match which Dr. Ludwig introduced was extinguished, if they stayed.

The plant has her own good reasons, moreover, for wishing to get rid of her visitors. Not only are their services required in carrying away the pollen, but if they stayed longer they might be dangerous, for snails are greedy creatures, and if not dismissed would begin to devour the young fruit-germs and other fleshy parts of the plant. Many aröids, indeed, allow their hungry guests to feed upon the sheaths, which soon cease to be required for the protection of the fruit; but in the great majority of species all the green portions are so virulently poisonous that not the smallest bite can be taken with impunity. Were it otherwise, indeed, the snail would naturally begin to devour the first leaf which came in its way without taking the trouble to climb the long stalk—an arduous journey for a small snail, which is only tempted upwards, like the boy who climbs a greasy pole, by the prospect of something very nice at the top. Having been regaled, however, with a delicious drop of nectar and made comfortable for the night, the snail at once departs, crawls up the sheath, brushing off pollen as it goes, then down the stalk, and without delay begins to mount another, just as other blossoms are announcing by their fragrance that they are in want of its services.

"And thus," as Carus Sterne, to whom we are indebted for most of the above facts, remarks, "the flowers receive the needful pollen by the fastest snail express."

SELINA GAYE.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

SOCIOLOGICAL SECTION.

At the opening meeting of the Sociological Section for the current session, held at the Mason College, on Thursday, 15th October, 1885, Mr. W. R. Hughes, F.L.S., the President, delivered a brief address, in which he alluded to the satisfactory progress of the Section, and to the number of accomplished masters and students of the respective sciences embraced in the "Synthetic Philosophy" who had kindly rendered assistance to the Section. The Section had systematically gone through Mr. Herbert Spencer's "Essays on Education," and it was now engaged in a critical examination of "The Principles of Biology" and "The Study of Sociology." Mr. Hughes also alluded to the gratifying fact that within the last few days Mr. Herbert Spencer had completed and published a third edition of the first volume of "The Principles of Sociology." The volume was specially interesting to the Section, as it contained a subject-index which had been prepared —as a labour of love—by Mr. F. Howard Collins, F.L.S., one of the members, and which could not fail to be most valuable to students. The volume had also a new appendix C, and it contained about 2,500 references to 455 works quoted therein. Mr. Hughes also announced that Part VI. of "The Principles of Sociology—Ecclesiastical Institutions" was in the press and would be published immediately, and he was quite sure that the members would all join with him in heartily congratulating Mr. Herbert Spencer on the steady progress of his great work, and hoping that he may live to see its completion. Mr. Hughes then said:

I venture here to take the liberty of correcting a misconception. I am quite sure that it is not necessary to do so to the members of this section, but it will give them the opportunity to make the correction in their circle, and my remarks may perhaps be reported publicly. In an address delivered by the retiring President of the Birmingham Philosophical Society to the members on this day last week he chose for his theme the extremely appropriate and well-timed subject, "The progress of the doctrine of Evolution." No one in Birmingham is in greater sympathy with this subject, and no one is capable of handling it from certain aspects more efficiently than my friend, Mr. Lawson Tait; moreover, he is not only an able but a generous-minded man, and a lover of fair play. I own I must confess to a considerable amount of surprise and regret at reading in the *Birmingham Daily Post* of the 9th instant a report of that address in these words, which I cannot pass unnoticed:—"His (Mr. Lawson Tait's) discourse consisted of an interesting review of the development of scientific knowledge during the last twenty-five years, and more especially of the manner in which corroboration had been furnished of the Darwinian theory of Evolution." It will be perceived that the above extract is in the third person, and therefore I am unavoidably prevented from using Mr. Lawson Tait's exact words, but I am open to correction if I have misread them, but I do not think I have; and moreover the subsequent matter reported in the *Daily Post* contains internal evidence that the above quotation from Mr. Lawson Tait's address is right in spirit if not in letter. What I take serious exception to is the omission of the mention of Mr. Herbert Spencer's name in connection with the doctrine of Evolution. His very existence is apparently ignored, for his name does not appear once in the newspaper report. I hope it may not be so when the address is published *in extenso*. Every student of Evolution knows, or should know, if he cares to have before him all the facts, that the illustrious Charles Darwin applied to animals and plants the hypothesis of the natural selection of favourable variations as the main *factor* in the *process* of *Organic* Evolution. On the other hand Mr. Herbert Spencer's formula of Evolution in general, expressed the transformation going on everywhere throughout the Cosmos; and he applied the ultimate physical laws by which the transformation is caused, to the interpretation of all progress—inorganic, organic, and superorganic. For the fullest evidence of the truth of my statement I turn to the twenty-ninth volume of the *Westminster Review* for the month of April, 1857, wherein appears an essay from the pen of Mr. Herbert Spencer, entitled "Progress: its Law and Cause," and at page 465 of that essay are these remarkable words:—

"We believe we have shown beyond question that that which the German physiologists have found to be the law of organic development is the law of all development. The advance from the simple to the complex, though a process of successive differentiations, is seen alike in the earliest changes of the universe to which we can reason our way back, and in the earliest changes which we can inductively establish; it is seen in the geologic and climatic evolution of the earth, and of every single organism on its surface; it is seen in the evolution of humanity, whether contemplated in the civilised individual or in the aggregation of races; it is seen in the evolution of society in respect both of its political and economical organisation; and it is seen in the evolution of all those endless concrete and abstract products of human activity which constitute the environment of our daily life. From the remotest past which science can fathom down to the novelties of yesterday, that in which progress essentially consists, is the transformation of the homogeneous into the heterogeneous."

It is, I conceive, not too much to maintain that the preceding words contain the whole "promise and potency" of the doctrine of Evolution. They are a *multum in parvo*, and an examination of this essay, which is reprinted (as revised) in Volume I. of Mr. Herbert Spencer's "Essays," will convince the most wavering sceptic of the truth of my assertion. Judge for yourselves, ladies and gentlemen, if the titles to the headings of the pages of this wonderful Essay, running from 445 to 485 inclusive, do not of themselves indicate its full scope and bearing. They are :—

The Nebular Hypothesis.
Physical Development of the Earth.
The Theory of a Biological Progression.
Evolution of Society.
Industrial Organisation.
Spoken and Written Language.
Painting and Sculpture.
Poetry, Music, and Dancing.
Development of Music.
Probability of a Common Cause.

Exposition of the Cause.
The Cause Geologically Illustrated.
The Cause Illustrated in Physical Geography.
The Cause Illustrated in Chemistry.
The Cause Illustrated in Embryology.
The Cause Illustrated in Palæontology.
The Cause Illustrated in Social Evolution.
The Cause Illustrated in Science.
Concluding Reflections.

Ladies and gentlemen, you know very well, and the thousands of readers of Mr. Herbert Spencer both here and in America know very well, that these are the cardinal truths of the "Synthetic Philosophy" which Mr. Herbert Spencer has devoted his life-time to working out. One word more. You will have perceived that the date of Mr. Herbert Spencer's Essay is 1857, whereas Darwin's great work on the "Origin of Species" appeared in the year 1859, so that we are enabled with certainty to fix the date of the first promulgation of the idea of a comprehensive theory of Evolution at twenty-eight years ago, and not at twenty-five years ago as stated by Mr. Lawson Tait. It should further be noted that in the "Principles of Psychology," published so far back as 1855, Mr. Herbert Spencer interpreted the phenomena of mind, alike in all lower creatures and in man, as consequent upon processes of Evolution. Credit must, however, be given to many other workers in the same field, and the honoured names of Erasmus Darwin, Lamarck, Geoffroy St. Hilaire, Goëthe, Wolff, Von Baer, Henri Milne Edwardes, Robert Chambers, Professors Huxley and Haeckel, Alfred Russel Wallace, and others, must not be omitted as having contributed largely to the Biological cause, and the distinguished French philosopher, Auguste Comte, to the Sociological cause. Nevertheless it must ever remain an incontrovertible fact that Mr. Herbert Spencer was the first exponent to broach the doctrine of Evolution; and he is the only Englishman who has formulated a complete system of Synthetic philosophy showing its all-embracing scope.

Far be it from me to cast the faintest breath against the merits of the illustrious Darwin, who himself constantly quoted Mr. Herbert Spencer in support of his views, and spoke of him as "Our great philosopher." I perfectly agree with Mr. Alfred Russel Wallace that Darwin cannot be over-rated, and I also perfectly agree with Mr. Wallace in thinking that "If other principles should hereafter be discovered, or if it be proved that some of his subsidiary theories are wholly or partially erroneous, this very discovery can only be made by following in Darwin's steps, by adopting the method of research which he has taught us, and by largely using the rich stores of material which he has collected, but I am nevertheless a firm believer in the time-honoured proverb "Honour to whom honour is due," and I think I have made it clear that the theory of Evolution which Darwin applied to plants and animals Mr. Herbert Spencer applied, and applied previously too, to everything here and elsewhere. Listen to what Professor John Fiske, the eminent American philosopher and Spencerian, in a charming little book called "The Destiny of Man," published in 1884, says of both Darwin and Spencer. Speaking of one of Darwin's laws, known as "Natural Selection," he says: "Reckless of good and evil, it brings forth at once the mother's tender love for her infant and the horrible teeth of the ravening shark, and to its creative indifference the one is as good as the other." Of Spencer he says: "The greatest philosopher of modern times, the master and teacher of all who shall study the process of Evolution for many a day to come, holds that the conscious soul is not the product of a collocation of material particles, but is in the deepest sense a divine effluence. According to Mr. Herbert Spencer, the divine energy which is manifested throughout the knowable universe is the same energy that wells up in us as consciousness."

* * * *

"Our wills are ours, we know not how;
Our wills are ours, to make them thine.
Our little systems have their day;
They have their day and cease to be;
They are but broken lights of thee,
And thou, O Lord, art more than they."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 281.)

Near to Chipping Warden there are two sections of the Marlstone; the one nearest the village showing about five feet of the rock-bed, with, at the top, some portions of the Transition-bed containing many gasteropods. The best section, however, in this neighbourhood is one situated about a mile from Chipping Warden towards Byfield. The Transition-bed here has yielded to the careful working of Mr. Walford a very large number of interesting fossils, but there is comparatively little to be done now. The list of fossils I give includes only those that I and Mr. W. D. Crick (who worked much of the district with me) have been able to procure.

MR. WILSON'S PIT, CHIPPING WARDEN.	Feet	In.
1.—Soil	1	0
Upper Lias.		
2.—Light-grey clay, containing small *ammonites* and *belemnites*, also irregular blocks of white limestone in the upper part—the remains of the LOWER CEPHALOPODA-BED	2	2
3.—FISH-BED; a limestone in two bands, some of it violet coloured inside. Upper part in small irregular pieces, easily broken; lower part larger blocks, harder, and looks water worn in places; containing *Ammonites serpentinus*, *A. Holandrei*, *A. acutus*, *Euomphalus minutus*, *Fish remains, &c.*	0	3½
Middle Lias.		
4.—TRANSITION-BED; clay, and grey friable sandy marl, very red in places; the marl very fossiliferous, containing *Ammonites Holandrei*, *A. acutus*, *A. communis*, *Belemnites—several species*, *Chemnitzia foveolata*, *Cerithium ferreum*, *Alaria unispinosa*, *Eucyclus Gaudryanus*, *E. conspersus*, *Phasianella morencyana (?) or Phasianella Burignieri (?) Cryptænia consobrina*, *Actæonina Ilminsterensis*, *Ostrea sportella*, *Pecten æquivalvis*, *Plicatula spinosa*, *Cucullæa Münsteri*, *Astarte subtetragona*, *Astarte striato-sulcata*, *Leda Galatea*, *Cardinia philea*, *Rhynchonella tetrahedra*, *Terebratula cornuta?* *Ditrypa etalensis*, *Diastopora liassica*, *&c.* ...	0	6
Small ironstone concretions and crystallised carbonate of lime in the lower part.		
5.—Ferruginous limestone similar to rock-bed. Lower part very fossiliferous—broken shells chiefly. *Large belemnites*, *Pecten liasinus*, *Pecten æquivalvis*, *Pentacrinus*, *Rhynchonella tetrahedra*, *var. Northamptonensis*	0	3
6.—Sandy marl, very much like the Transition-bed, but the fossils larger; the Rhynchonellæ mostly as separated valves. Many crushed specimens and broken shells, *Gasteropods*, *Encrinite stems*, *Rhynchonellæ*, *Bivalves*	0	3

7.—MARLSTONE ROCK-BED, a ferruginous limestone, very red exterior, usual fossils.

The bed No. 5 is so nearly like the rock-bed that it is pretty evident it is formed of material arising from the denudation of some portion of the rock-bed near at hand, possibly no further away than ASTON-LE-WALL, because at this latter place there is distinct evidence of erosion. (See section below.)

RECTORY PIT, ASTON-LE-WALL.

	Feet	In.
1.—Soil ... ... 1ft. to	1	6
Upper Lias.		
2.—Greyish clay, with remains of *Cephalopoda-bed* ...	1	7
3.—FISH-BED, a whitish limestone, violet interior, containing a few *Ammonites* and *Belemnites* *Middle Lias.* 4.—TRANSITION-BED, a rather hard limestone passing into No. 3, but easily recognised as the Transition-bed, containing *Ammonites acutus*, *Chemnitzia foveolata*, *Actæonina Ilminsterensis*, *Trochus*, *Plicatula spinosa*, *Encrinite stems*, *&c.*	0	6
5.—Clay or marl. In places this is absent, and its place entirely taken up by hard stone of the Transition-bed	0	1
6.—MARLSTONE ROCK-BED, top part crowded with broken and worn *Rhynchonellæ*, *Belemnites*, *Ossicles*, *&c.* ... ... about	6	0

The accumulation and packing together of broken shells at the top of the rock-bed here shows that it was, for a time at least, exposed to the action of moving water, either from actual exposure to the atmosphere, or from being sufficiently near the surface of the water to be affected by shallow currents or wave action.

About a hundred yards from the Rectory Pit just described, and nearly opposite the houses at APPLETREE, is a small section almost identical with the last, the grey clay No. 2 being a little thinner.

In the valley south of Byfield and near to Warden Grange is a small marlstone quarry which has not been worked for a long time. The section is as below.

SECTION NEAR TO WARDEN GRANGE.

	Feet	In.
1.—Soil, with blocks of limestone	1	3
2.—Light grey marly clay	2	9
3.—Hard white limestone, purple interior, *Ammonites* rather abundant, *Fucoid impressions*, &c. ...	0	4

4.—Reddish sandy clay, passing downwards into a grey marl—the usual form of the Transition-bed. The upper part of the clay contained some badly-preserved fossils of a similar kind to those found in the marl	0	7
5.—Rock-bed.		

I have already referred to the sections on the East and West Junction Railway as being about the best in the county for showing the sequence of beds from the lower part of the Upper Lias to nearly the base of the "*Margaritatus*" *Zone* of the Middle Lias. The several small cuttings extending from Byfield Railway Station to near Aston-le-Wall show successively lower beds, so that in order to verify the section given below it would be necessary to walk some mile and a half along the line.

Section on the East and West Junction Railway near to Byfield.

	Feet	In.
1.—Soil	—	
2.—Clay mixed with gravel, apparently unfossiliferous	8	0
"*Communis*" *Beds*—		
3.—Upper Cephalopoda-Bed; a flaggy limestone, whitish surface, violet interior, containing *Ammonites bifrons*, *A. Holandrei*, *Belemnites*, *Pectens*, *Astarte*, *&c.*	0	6
4.—Clay-Marl, breaks into somewhat cubical blocks, little white concretions very numerous, containing *Ammonites communis* (abundant), *A. bifrons*, *some small "falcifer" ammonites*, *Belemnites*, *Astarte*, *Pentacrinite joints*	8	0
"*Serpentinus*" *Beds*—		
5.—Lower Cephalopoda-Bed; a yellowish, hard, sandy limestone, dirty violet coloured interior, not flaggy, many small white concretions, containing *Ammonites serpentinus*, *A. exaratus*, *A. Holandrei*, *A. communis*, *A. Levisoni*, *Belemnites*, *Fucoid impressions*	0	9
6.—Light Coloured Marl, nearly white, not very homogeneous in composition, breaks into cubical masses, many white concretions, fossils very scarce	8	0
"*Fish and Insect*" *Beds*—		
7.—Shale, scarcely distinguishable from bed above in the section, containing *Flattened ammonites*, *Belemnites*, *Fish Scales*	0	1

	ft.	in.
8.—**Fish-Bed**, somewhat nodular, nearly white exterior, dark purplish inside in places, not a continuous bed, containing *many* "*Planulate*" *ammonites*, *a few* "*Falcifer*" *ones*, *Belemnites*, *Euomphalus minutus*, *Fish fragments*, *Wood*, *&c.*	0	4
"*Transition*" *Bed.*		
A.—Layer of dark blue and red sandy clay, very much mixed up; no fossils noticed	0	8
A yellowish sandy limestone, rather soft, the fossils only casts, with here and there a harder piece from which a few fossils could be obtained. *Ammonites acutus*, *Macrodon*, *Gasteropods*, *&c.*	0	4
"*Spinatus*" *Zone.*		
B.—**Rock-Bed**, a sandy limestone, containing a good deal of iron, layers of *ossicles*, "Jacks," several irregular inconstant partings of red sand. Fossils in sandy part only casts. *Usual fossils*, *Waldheimia resupinata* rather abundant ...	6	0
C.—**Marly Clay**, containing concretionary ferruginous nodules	1	6
D.—**Shaly Ferruginous Limestone**, rather sandy, fossils fairly abundant. *Ostrea cymbium*, *Pecten liasinus*, *Limea acuticosta*, *Protocardium truncatum*, *&c.*	0	4
E.—**Marly Clay**, similar to "C."	2	7
"*Margaritatus*" *Zone.*		
F.—**Sandy Ferruginous Limestone**, rather soft and shaly, containing *Ammonites margaritatus* in abundance, *Pleuromya costata* (abundant), *Turbo aciculus*, *Ostrea cymbium* var. *obliquata*, *Plicatula spinosa*, *Inoceramus substriatus*, *Modiola numismalis*, *Cardita multicostata*, *&c.* (see p. 188)	8	2
G.—**Sandy Marl**, containing *Ammonites margaritatus*, *&c.*	6	2
H.—**Soft Sandy Limestone**, containing *Ammonites margaritatus*, *Pholadomya ambigua* in abundance, *Fucoid impressions*, *&c.* (see p. 187)	8	8

Beds 1 to 8, as also A and B, may be best examined near to Byfield, both along the line and in a small quarry on the south side of the line; D to H, best on the south side of the line near to Byfield Pool, though since the line has been put in working order again none of the beds below B can be well seen. I may add that I have never myself seen the soft beds C, E, and G, the description of them having been taken from Mr. Walford's pamphlet. Mr. Walford says that a hard shelly limestone containing *Cardita multicostata* was met with below, and this, I certainly think, would be "L" of the typical section. On one occasion I found a single block of stone on the line containing the following fossils:—*Cardita multicostata*, *Ostrea*, *Pecten æquivalvis*, *Protocardium truncatum*, *Cardinia antiqua*, *Cardinia lævis*, *Astarte striato-sulcata* (abundant), *Turbo* (near to *nudus*), *Serpulæ*, *&c.*, and this I considered as being a part of the bed "L." There are several small "faults" in this neighbourhood; one not far from the station at Byfield can be traced across the line; also part of this, or another small one, may be seen in the quarry near at hand. Another is to be found just by the side of PRIOR'S MARSTON ROAD BRIDGE, the line of dislocation running N.E. by N. to S.W. by S. The beds of the Marlstone and Upper Lias here have a gentle dip westward, and the "fault" has only had the effect of altering the dip and position over a space of about twenty yards. Still another "fault" is found a little beyond Byfield Pool.

(To be continued.)

NOTES ON THE FLORA OF AMERICA,

MADE DURING A TOUR IN THE NORTH-EASTERN STATES IN APRIL, MAY, AND JUNE, 1882.

BY W. H. WILKINSON,

HON. SEC. BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 276.)

AMERICAN PLANTS

COLLECTED IN APRIL, MAY, AND JUNE, 1882, BY W. H. WILKINSON.

Named and classified from the "American Botanist" of Alphonso Wood, A.M.

NATURAL ORDER, 1.—RANUNCULACEÆ.

Name.	Place where found.
Anemone parviflora......	Catskill Creek, Hudson River.
Hepatica trilobata	Au Sable Chasm and Saratoga.
Thalictrum dioicum......	St. Helen's Island, Montreal, Canada.
Ranunculus sceleratus ..	St. Helen's Island, Montreal, Canada.
,, recurvatus ..	Mount Royal, Montreal, Canada.
,, tomentosus ..	Fort McHenry, Baltimore.
,, palmatus	Central Park, Chicago.
Aquilegia Canadensis	St. Helen's Island, Montreal.
,, formosa	Rocks, Niagara Falls.
Actæa spicata	Islands, Niagara Falls, and St. Helen's Island, Montreal.

NATURAL ORDER, 6.—BERBERIDACEÆ.

Podophyllum peltatum (May apple) .... Fort McHenry, Baltimore.

NATURAL ORDER, 8.—SARRACENIACEÆ.

Sarracenia Gronovii...... Botanic Gardens, Washington.

NATURAL ORDER, 9.—PAPAVERACEÆ.

Sanguinaria Canadensis.. Island, Niagara Falls.

NATURAL ORDER, 10.—FUMARIACEÆ.

Dicentra cucullaria (White Ear-drop) .... Island, Niagara Falls.

NATURAL ORDER, 11.—CRUCIFERÆ.

Arabis Canadensis ...... Fort William Henry, Lake George.
Cardamine laciniata...... Goat Island, Niagara Falls. Woods. Plentiful.
Sisymbrium canescens (Tansy Mustard).... Kingston, Canada.
Capsella Bursa-pastoris .. Fort McHenry, Baltimore.
Lepidium ruderale ...... Fort McHenry, Baltimore.
Lunaria rediviva .... Niagara Falls, Canada.

NATURAL ORDER, 14.—VIOLACEÆ.

Viola pubescens.......... St. Helen's Island, Montreal.
,, Canadensis .... St. Helen's Island, Montreal.
,, palustris .... St. Helen's Island, Montreal, and Clarke Hill Islands, Niagara Falls.
,, blanda .... Au Sable Chasm, Cedar Island, Niagara Falls.

NATURAL ORDER, 17.—DROSERACEÆ.

Dionæa muscipula ...... Botanic Gardens, Washington.

NATURAL ORDER, 19.—CARYOPHYLLACEÆ.

Dianthus viscidus........ Washington Heights, New York.
Stellaria longipes........ Fort William Henry, Lake George.
Arenaria Canadensis .... Catskill, Hudson River.
,, rubra, var. Canadensis.
,, serpyllifolia .... Fort William Henry, Lake George.
Mœnchia quaternella (Weed) .... Botanic Gardens, Washington.

NATURAL ORDER, 20.—PORTULACACEÆ.

Claytonia Virginica ...... Island, Niagara Falls.

NATURAL ORDER, 30.—GERANIACEÆ.

Oxalis stricta............ Saratoga, Lake George, Catskill, and Washington.
Geranium Robertianum.. Kingston, Lake Ontario, Canada.
,, maculatum.... Woodland Park, Saratoga.

NATURAL ORDER, 36.—ANACARDIACEÆ.

Rhus Cotinus............ Central Park, New York.

NATURAL ORDER, 37.—SAPINDACEÆ.

Acer saccharinum ...... Kingston, Ontario, and Washington.

NATURAL ORDER, 41.—VITACEÆ.

Vitis riparia .... Cedar Island, Niagara Falls.

Natural Order, 42.—Polygalaceæ.

Polygala Hookeri .... Fort William Henry, Lake George.

Natural Order, 43.—Leguminosæ.

Melilotus officinalis ...... Boston and Baltimore.
Medicago lupulina .... New York and Baltimore.
Trifolium agrarium ...... Catskill.

Natural Order, 44.—Rosaceæ.

Rubus Canadensis ...... Kingston, Ontario, and Lake George.
,, hispidus (?) ...... Catskill, Hudson River.
,, trivialis.......... Fort William Henry, Lake George.
,, simplex (?) ...... Fort William Henry, Lake George.
,, flagellans .... Clarke Hill Island, Niagara Falls.
,, triflorus.......... Caldwell, Lake George.
,, odoratus .... Catskill, Hudson River.
Potentilla Canadensis .... Lake George, Niagara Falls, and Baltimore.
,, argentea ...... Fort William Henry, Lake George.
Rosa rubiginosa........... Kingston, Lake Ontario.
Amelanchier Canadensis.. Niagara Falls, Canada.
,, Botryopium.. St. Helen's Island, Montreal.
Cratægus arborescens .... Central Park, Chicago.

Natural Order, 45.—Saxifragaceæ.

Mitella diphylla .... Toronto, Canada.
Saxifraga Virginiensis.... Au Sable Chasm.
Deutzia gracilis.......... Park, New York.
Ribes floridum .... St. Helen's Island, Montreal.
,, gracile .... Niagara Falls, Canada.
,, aureum............. Rocks, Niagara Falls.
,, Cynosbate.......... Kingston, Ontario.

Natural Order, 46.—Crassulaceæ.

Penthorum sedoides...... Island, Niagara Falls.

Natural Order, 63.—Umbelliferæ.

Hydrocotyle sibthorpioides Fort William Henry, Lake George.
Thaspium aureum .... Au Sable Chasm.
Pimpinella integrifolia.... Catskill, Hudson River.
Chærophyllum procumbens Washington.
Daucus Carota .... Fort McHenry, Baltimore.

Natural Order, 66.—Caprifoliaceæ.

Lonicera ciliata (Xylosteum ciliatum) ..... Niagara Falls.
Sambucus Canadensis ... Kingston, Lake Ontario.

Natural Order, 67.—Rubiaceæ.

Houstonia serpyllifolia ... Fort William Henry, Lake George.

Natural Order, 70.—Compositæ.

Aster spectabilis .... Catskill, Hudson River.
Diplopappus linariifolius.. Niagara Falls, Canada.
Gnaphalium uliginosum.. Niagara Falls, and Catskill, Hudson River.
Cacalia diversifolia (?).... Island, Niagara Falls.
Lappa officinalis......... Chicago, Lake Michigan.

NATURAL ORDER, 72.—CAMPANULACEÆ.

Campanula aparinoides .. Taunton, Mass.

NATURAL ORDER, 73.—ERICACEÆ.

Vaccinium corymbosum.. Au Sable Chasm.
,, Pennsylvanicum Fort William Henry, Lake George.

NATURAL ORDER, 81.—PRIMULACEÆ.

Trientalis Americana .... Au Sable Chasm.
Lysimachia thyrsiflora .. Fort William Henry, Lake George.

NATURAL ORDER, 82.—PLANTAGINACEÆ.

Plantago cordata .... Catskill Creek, River Hudson.

NATURAL ORDER, 88.—SCROPHULARIACEÆ.

Verbascum Thapsus...... Niagara Falls and New York.
Verbascum Blattaria .... Washington Heights, New York.
Pentstemon pubescens.... Catskill Creek, Hudson River.
Veronica arvensis........ Botanic Gardens, Washington.
,, officinalis .... Woodland Park, Saratoga.
,, serpyllifolia .... St. Helen's Island, Montreal.

NATURAL ORDER, 91.—LABIATÆ.

Lamium amplexicaule.... Botanic Gardens, Washington.

NATURAL ORDER, 92.—BORRAGINACEÆ.

Echium vulgare.......... Catskill, Hudson River.
Cynoglossum officinalis .. Fort William Henry, Lake George.
Lithospermum linearifolium .... Niagara Falls, Canada.

NATURAL ORDER, 100.—ASCLEPIADACEÆ.

Asclepias quadrifolia . ... Catskill, Hudson River.

NATURAL ORDER, 104.—POLYGONACEÆ.

Rumex Acetosella .... Fort McHenry, Baltimore.

NATURAL ORDER, 113.—EUPHORBIACEÆ.

Euphorbia Helioscopia .. Niagara Falls, Canada.

NATURAL ORDER 122.—CUPULIFERÆ.

Quercus nigra (?) .... La Fayette Park, Washington.
Fagus ferruginea .... La Fayette Park, Washington.
Corylus Americana ...... Niagara Falls, Canada.

NATURAL ORDER 124.—MYRICACEÆ.

Comptonia asplenifolia .. Au Sable Chasm and Fort William Henry.

NATURAL ORDER 127.—CONIFERÆ.

Juniperus communis .... Kingston, Lake Ontario.
Thuya occidentalis ...... Niagara Falls, Canada.

ENDOGENS.

NATURAL ORDER, 142.—IRIDACEÆ.

Iris versicolor .... Fort William Henry, Lake George.
Sisyrinchium Bermudiana St. Helen's Island, Montreal, and Fort William Henry, Lake George.

NATURAL ORDER, 146.—TRILLIACEÆ.

Trillium grandiflorum .. Goat Island, Niagara Falls.
,, erectum .... The Rapids, Niagara Falls.

NATURAL ORDER, 147.—LILIACEÆ.

Allium sativum .... Baltimore and New York.
Smilacina stellata ...... Goat Island, Niagara Falls.
,, ciliata .... Kingston, Lake Ontario.
,, trifoliata ...... Fort William Henry, Lake George.
,, bifolia .... Fort William Henry, Lake George.
Myrsiphyllum asparagoides Conservatory, Washington.

NATURAL ORDER, 154.—CYPERACEÆ.

Scirpus palustris .... Niagara Falls, Canada.
Eriophorum capitatum .. Fort William Henry, Lake George.
Carex flava.............. Fort William Henry, Lake George.

NATURAL ORDER 155.—GRAMINEÆ.

Zea Mays .... New York, Indian corn cobs.

NATURAL ORDER, 157.—LYCOPODIACEÆ.

Lycopodium dendroideum Quebec, Canada.

NATURAL ORDER, 158.—EQUISETACÆ.

Equisetum limosum .... Niagara Falls, Canada.

NATURAL ORDER, 159.—FILICES.

Lastrea montana .... St. Helen's Island, Montreal.
,, Thelypteris...... St. Helen's Island, Montreal.
Aspidium acrostichoides.. Au Sable Chasm, Lake George.
Polypodium vulgare ..... Cedar Island, Niagara Falls.
Asplenium Fabianum .... Greenhouse, Alleghany City.
Osmunda interrupta...... Au Sable Chasm, Lake George.
Onoclea sensibilis........ Fort William Henry, Lake George.
Adiantum pedatum ...... Au Sable Chasm, Lake George.

MOSSES.

Bryum nutans............ Fort William Henry, Lake George.
,, cæspiticium ...... Baltimore and Lake George.
,, ... Baltimore and Lake George.
Funaria hygrometrica.... Niagara Falls and Lake George.
Climacium Americanum.. Niagara Falls.
Mnium affine (?) .... Niagara Falls.
,, undulatum .... Niagara Falls.
Amblystegium irriguum .. Niagara Falls.
Polytrichum commune... Fort William Henry, Lake George.
Hypnum rutabulum...... Fort William Henry, Lake George.

HEPATICÆ.

Marchantia polymorpha.. Fort William Henry, Lake George.

LICHENS.

Cladonia furcata (?) ....

FUNGI.

Æcidium grossulariæ ....
Schizophyllum commune On gatepost, Washington.

ANTHROPOLOGY, ITS MEANING AND AIM.

BY JOSEPH SMITH, JUN., M.A.I.

(Continued from page 291.)

Up to the time of Buffon, although naturalists had studied the various creatures of the animal and vegetable worlds, it had not occurred to those entering into scientific investigation to study man from the same point. He had been regarded and studied as an individual; and Anthropology may be looked upon as having originated with the great thought of Buffon, that man must be studied as a species. Buffon was the first to investigate and regard man as a species, and he devoted his attention to the examination of his colour, physique, and external traits and characteristics. He was succeeded by Camper, a Dutchman, who began the study of skulls, showing that if we would understand the position of man this *comparison* must be of great importance in any laws of Anthropology. He compared the Negro skull with that of the European and the Ourang-outang, pointing out the facial angle, and drawing certain conclusions from it; but Blumenbach, a doctor of the German school, who may be regarded as the legitimate father of the science, pointed out the unsatisfactory results of these facial angular measurements, resulting from the union of two lines, one of which touches the forehead, and the other, drawn from the orifice of the ear, meets the former line at the orifice of the front teeth; and argued that the study of skulls, to be of any scientific value, must not be made individually but in lots, and subject to recognised rules. It was he who made the fundamental division of the human race into five sections, viz.:—

The European, or white race;
The Asiatic, or yellow race;
The African, or black race;
The American, coloured; and
The Malay,

on which, up to recent times, anthropological investigations have been principally based. This division, however, is far from perfect, and forms at the present time one of the most obscure problems of scientific anthropology. The great ideal of Blumenbach was the Unity of mankind, which, in his days, was not a generally accepted fact, and it was in opposition to the assertions, grave descriptions, mythological ideas, and theories regarding this human unity, which had been put forward even as late as the time of Voltaire,* that he worked; the happy results of his labours eventually being the establishment of this ideal. Anthropology like other sciences had to be followed on fixed laws, or rules, and one of the principal of these is to draw a distinction everywhere between what belongs to the brute and what belongs to the man; then regard the position of man to animals. The capacity of brain power must be noted as being of the utmost consequence, and in his calculations Camper based his conclusions on the assimilation of the facial angle in the skull of the Negro to the angle derived from the cranium of the ourang-outang, and calculated his conclusions rather on this angle than on the cranial capacity. But although the skull of the Negro may show a lesser angle than that of the European, yet the capacity of the brain is, with a slight variation, the same. A further principle to be observed when investigating matters relating to man and his position in creation, is to admit no fact which is not supported by trustworthy documents, since, by strict adherence to this, everything which is puerile or tending to exaggeration and legend will be eliminated and excluded from science, while one of the most important factors in this branch of knowledge is to observe that all comparisons from extreme to extreme be only made by means of all the intermediate terms and shades possible. Comparison within recent years has been only by extremes, but anthropologists have endorsed the theory of Blumenbach that it is only the extremes which seem to separate the human species into specific and decided races; the gradual shades and continuous intermediate terms marked in man making him form but one mankind.

Man must again be studied under three divisions, for on such is the true study of man founded—*Philology and History, Relation of Races to Climates*, and *Migrations and Intermixtures.* In the investigation of man under this last head Philology comes into practical use, assisting and showing how to trace to their origin the various migrations and different minglings of race with race.

The science lost its progenitor in 1840. Amongst the many rules this great anthropologist laid down was the great and general classification based on the characters presented by the configuration of the head, so different in the different races as to the proportion of the skull to the face, and the proportion of the encephalon to the organs of sense and jaws.

* The great naturalist Linnæus even erred so far as to describe man and arrange him in the same genus as the ourang-outang, the *Homo nocturnus, H. Troglodytes*, and *H. sylvestris* of that naturalist being no other than the ourang.

The quintal arrangement of Blumenbach is called in question as either having too wide a scope or not being sufficiently indicative of its meaning, and Waitz seems to think that this arrangement was founded on the corresponding geographical scheme of five parts of the globe.

According to this division the Ethiopian, or black, and Mongolian were made to indicate the two extremes, the White race taking its place as the centre of the division, the American intervening between the White and Mongolian races, and the Malay between the Ethiopian and the White race or Caucasian; thus—

Mongolian;
American;
White race, or Caucasian;
Malay;
Ethiopian, or black;

by which, assuming the unity of the human race, the Caucasian is made the centre of the system, and consequently must be regarded as the normal type of the human race. This system has, however, been proved untenable so far as the position of the various divisions one to the other is regarded, for in taking into consideration not only the shape of the skull but other anatomical differences and developments, Waitz maintains that the White race and Negro, form the two extremes in any scale of division, the latter on account of his resemblance to the ape, the former because in him this apish resemblance almost entirely disappears.

Notwithstanding the diversity of opinion which may have greeted the enunciation of such an hypothesis, there is so much in the crude theory of Blumenbach that it formed the basis of further investigation, which resulted in the tabular arrangement I have previously given. Anthropologists even at the present time are, from their investigations, inclined to opinions which do not run in direct harmony with the tables laid down either by Blumenbach or Waitz. Lacepede and Dumene were inclined to increase this quintal table by the addition of a sixth division or variety, embracing the Hyperborean race of the polar regions; while Virez ("Nat. Hist. du Genre Hum.," i., p. 318, 1834), points out as the sixth variety the Hottentots and Papuans. Cuvier, the naturalist, based his arguments on three varieties, viz., the Mongol, Negro, and Caucasian, which may indeed be accepted as the three pivots of the derivation of nations and races; and while Pritchard, Smith, and Latham are inclined to adopt the division into five sections, Pickering assumes eleven, Bary fifteen, Desmoulins sixteen, and Agassiz and Nott assume an indefinite number of species. So too, in speaking of the inhabitants of Australia, who are regarded as belonging to and springing from one family by all anthropologists, Hombron ("Zoology," i., p. 312, in Urville, Voy. au Pole Sud) speaks of them as being members of different varieties, and considers the inhabitants of Van Dieman's Land as belonging to a distinct species.

Waitz ("Anthropology," vol. i., p. 234), commenting on the division established by Cuvier, says:—"If the Malay and the American be added to the three chief forms adopted by Cuvier, we can scarcely avoid adding the Australians, Austral Negroes (Negrillos), the Papuans, and the Hottentots. Nor will this be sufficient; all the intermediate tribes between the Negroes and the White, namely the Kaffirs, Nubians, Gallas, Abyssinians, and Berbers, have an equal claim to consideration. This applies also to the Battas, the cranial form of whom is intermediate between that of the Europeans and Malays." With the Mongolian type there is further associated the so-called Hyperborean type, though the assumption of a separate polar race presents many difficulties, and, as already shown by Vater in his "Mithridates" (vol. iii., p. 317), indicates a considerable deviation.

But least of all can the aboriginal Americans be comprehended in the division, for whatever Morton and his school may assert as to the similarity of the cranial type in all the varieties of South and North America, it is shown by their own researches that differences of shape are as considerable there as in those parts in which they are considered fundamentally different. Some are long-headed and some are short-headed, others again are round-headed; the present Peruvians having small square skulls, with a compressed occiput ("Morton Cran. Am.," pp. 65-115); and Tschudi has pointed out three essential distinct cranial forms of the original inhabitants of Peru."

Retzius, however, was the first who reduced the study of the cranium to a fixed basis, which may be regarded as correct so far as it decides the shape and form of the skull. The basis of his theory was on the principle that "psychical individuality of a people must be founded on, and expressed by, the development of the brain, as indicated by the skull," and he established from his cranial observations two distinguishing classes, the dolichocephalous, from the Greek δολιχος, "long," κεφαλή, "head," which term is applied to distinguish a cranium elongated from front to rear, or, to express this idea numerically, a cranium the longitudinal diameter of which is to its transverse diameter as 100 is to 68; and the brachycephalous, derived from βραχυς, "short," κεφαλὴ, "head," applied to those skulls where the relation of the longitudinal to the transverse diameter is such as 100 is to 80. This principle, although much in use amongst anthropologists, has not that great merit of decision in disposing the crania in their relative position regarding nationality, which its author had anticipated; for both classes of these skulls may be found, and are, I may say, invariably found, amongst the same people; nor must it be supposed that the projection backwards of the cranium is a sign of inferiority, for even amongst our own race are found both long heads, or dolichocephalic, and short heads, the brachycephalic. The further observations of Retzius began to convince him that the law he had laid down was less infallible than he had at first considered it, and clearly showed that such characteristics would not be regarded as a criterion of intellectual excellence; but he further added two other distinguishing classes, or secondary classification, based on a point in the anatomical structure of the face, which is of more importance in anthropological calculation, Figuier asserts ("Human Race," p. 25), than any calculation made from the elongation of the cranium. This is the projectiveness of the human face, and has its description in the term *prognathism* from προ, "forward," and γναθος, "jaw," applying itself to describe the jutting forward of the teeth and jaws, and *orthognathism*, likewise derived from the Greek ὀρθος, "straight, and γναθος, "jaw," descriptive of the facial uprightness of the jaw. We now have the human crania in the following sections:—

1.—Gentes dolichocephalæ orthognathæ—or nations with long-shaped heads and uprightness in the jaw; or perhaps better, flat-faced.

2.—Gentes brachycephalæ orthognathæ—nations with short heads and flat faces.

3.—Gentes dolichocephalæ prognathæ—nations with long-shaped heads and protruding jaws.

4.—Gentes brachycephalæ prognathæ—short-headed nations, with projecting jaws.

Such were the divisions of Retzius, of which all four examples are met with in Asia in equal proportions; while the first and second, or examples of short-headed flat-faced and long-headed flat-faced crania, are found in Europe. The third and fourth division—the short-headed projecting-jawed and the long-headed projecting-jawed faces—predominate in the South Seas, not infrequently examples of the brachycephalæ orthognathæ being found, which may be explained by intermixture. Africa has a predominant type in the dolichocephalæ prognathæ, long headed and projecting jaws; and America gives us alternately forms belonging to the third and fourth divisions, dolichocephalæ prognathæ and brachycephalæ prognathæ, not excluding examples of the second, brachycephalic orthognathic type. Thus we have in Europe ("Muller's Archiv.," p. 271, 1848) examples of the brachycephalæ orthognathæ—short headed, upright jaws or flat faces, in the Turks, Lapps, Slavs, Basques; Asia giving examples of these crania in the Samoiedes, Burates, Afghans, and Persians. In the East Indies and South Seas the Tahitians, Malays, and Papuans belong to the brachycephalic prognathæ, or short-headed long-jawed examples; the Negroes, Hottentots, and Kopts being examples of the long-headed projecting-jawed races — dolichocephalic prognathæ. It will be noted from the foregoing remarks how great the variety and mingling of types is, and the questionable result of any attempt at classification on cranial mensuration only, when they transgress the distinguishing bond of the three chief types as illustrated by the Negro, the Mongol, and the European (Zeune in "Ueber Schädelbildung," 1846); yet the investigations of those who have done so much for Anthropology, although they may not quite harmonise with more recent discoveries, must not be depreciated, since they have aimed at elevating the study of man, and arriving at some recognised classification of the various types from the development of a cranial race theory. Nevertheless it is highly probable that there does exist a distinguishing type of national cranial form in every people, which, if only this could be established, would prove one of the greatest discoveries in the interests of Ethnography; but our knowledge of the variation of shape in individual national types is yet too small to enable us, with that precision so necessary to any science, to determine what ranges itself within, and what classes itself without, any particular type. The observations and studies of Hueck "De Craniis Esthonum," Zeune, Tschudi ("Muller's Archiv.," p. 277, 1845), and Meyer (Ibid, p. 510, 1850), all illustrate the difficulty of assuming the cranial form as an absolute mark of race, but I am inclined to believe that this apparent mingling of types can and will be eventually explained away by a careful investigation, and an attentive application of the rule set forth by Blumenbach, that any investigation must not be based on extremes, but that such studies must be made only by all the intermediate terms and shades possible, from extreme to extreme, since thereby the most minute variation will be detected, and an average figure or scale struck for the establishing of the normal type of a race cranium.

According to the measurements of Parchappe, "Recherches sur l'encéphale," races are placed in the following order according to the volume of the head:—Caucasians, Negroes, Mongols, Americans, and Malays. Lawrance differs from Parchappe in the estimation of brain capacity, and places the Malay between the Europeans and Mongols, while Tiedemann, "Der Hirn des Negers," 1837, gives the following as the mean capacity:—

	Cases.		Ounces.
European	135	......	$40\frac{2}{3}$
American	31	......	$40\frac{1}{3}$
Mongol	43	......	$39\frac{2}{5}$
Malay.......................................	77	......	$38\frac{1}{6}$
Adult Negro	48	......	$37\frac{11}{12}$
Asiatics and Negroes of the white race	39	......	$37\frac{2}{5}$

Various other writers, who have made independent measurements as to the mean average of the brain power, arrive at different standards, each out of unison with the other, so that no certainty can be drawn from such calculations in favour of the doctrine that capacity of cranium indicates the amount of mental endowment. In the commencement of this paper it was stated, on the authority of Camper, that the brain of the African (Negro) was equal to that of the European, which statement will require some modification if we look to the table of Tiedemann; but I argue that the brain of the African, if developed in the same ratio to that of the higher developed European, will be found to be equal, and moreover if the negro brain be set in comparison against that of a European subject of the same standard of intellectual endowment as the African, the computation of Camper will be found favourable. The variation which is found in skulls belonging to the same country and same age may be attributed to climatical influence, the method and habit of living, &c. Crantz inclines to the idea that the inhabitants of the northern parts have the body sinewy and square, those peoples dwelling in the south being of a more soft and elegant habit. This theory is endorsed by Leem, who treats on the Lapps and Finns; by Hogshorn, on the Lules; by Pallas, on the Calmucks; by Crantz, on the Greenlanders; and by Parkinson, on the New Zealanders and New Hollanders.

(To be continued.)

A WEEK'S WORK AMONG THE CANNOCK CHASE LEPIDOPTERA.

BY THOMAS GIBBS, JUNR.

The following notes on a week's stay at Colwich, working the Lepidoptera of Cannock Chase, may be interesting to your entomological readers.

My brother and myself arrived at Colwich on Monday afternoon, the 29th June, and left the following Saturday, so that we really had only five days' collecting; in that time, however, we were favoured with fine weather, and by hard work managed to come across several species that were new to us, and also to fill up some of the blanks in our collection.

The Butterflies were very poorly represented, the only species occurring in any abundance being *Cœnonympha pamphilus*, which swarmed all over the Chase.

Among the Bombyces we were more fortunate, taking amongst others *Hepialus velleda*, abundant among the bracken fern; *Lithosia mesomella*, a few specimens in marshy spots by streams on the Chase; *Nemeophila russula* and *plantaginis*, a few specimens of these two species flying over the moor in the sunshine; *Platypteryx falcataria* and *lacertinaria*, one specimen of each flying among birches by the ponds in Oakedge Park. We also found three larvæ of *Bombyx quercus* among the heather, and a batch of ova of *B. rubi* on the Wolseley park fence.

Among the Noctuæ we were very unsuccessful, owing probably to the cold nights. We sugared on two occasions, the only visitors being *Acronycta rumicis*, *Rusina tenebrosa*, *Agrotis strigula* (*porphyrea*), *Triphæna pronuba*, *Noctua plecta*, *Euplexia lucipara*, *Hadena thalassina*, and *H. oleracea*. *R. tenebrosa* and *A. strigula* were the only species that came at all freely. One day we saw *Anarta myrtilli* flying over the moor in some abundance; we managed to secure a few, but as all entomologists are aware they are much more easily seen than caught.

The Geometræ were more plentiful than any of the other groups, our captures numbering twenty-three species, of which the following were the best:—*Asthena luteata*, of this pretty little wave we took five specimens, among alders between the Oakedge ponds; in the same spot we found *Eupisteria obliterata* (*heparata*), *Melanippe sociata* (*subtristata*), *Coremia designata* (*propugnata*), and *Larentia viridaria* (*pectinitaria*), all rather common. *Ematurga atomaria* swarmed all over the moor, and there we also found *Aspilates strigillaria* and *Eubolia plumbaria*, both common; one *Panagra petraria* and two *Scodiona belgiaria*; *Bupalus piniaria* abounded among the Scotch firs; and we found the following species settled on palings—*Melanthia ocellata*, two specimens, and four species of *Eupithecia*, viz., *E. nanata*, abundant; *E. castigata* and *lariciata*, both fairly common; and two *E. pulchellata*.

Most of our time was spent on the Chase and in Oakedge Park, but one day we walked to Chartley, and took *Lycæna icarus* (*alexis*) and *Aspilates strigillaria* on the railway bank near Stowe station, and two specimens of *Acidalia fumata* and one of *Euclidea mi* on the famous Chartley Moss.

The above list of captures is not very extensive, but may serve to show how much can be done in a short time in one of the best localities in the Midland Counties; it includes several species that have not to my knowledge been previously recorded from the localities mentioned, notably *Lithosia mesomella*, *Scodiona belgiaria*, *Platypteryx lacertinaria* and *Nemeophila plantaginis* from Cannock Chase, and *Aspilates strigillaria* and *Acidalia fumata* from Chartley.

METEOROLOGICAL NOTES.—September, 1885.

The barometer was rather high at the commencement of the month, but fell decidedly till the 5th, when it rose, through a series of fluctuations, to the 22nd, its highest point (30·302 inches). Thence it fell till the end of the month, reaching 29·368 inches at 6 p.m. on the 30th. Temperature was rather above the average till the 22nd, when a "cold spell" set in, which reduced the mean to 54·7°, or nearly 2 degrees below the average. The highest readings were on the 15th, when 75·3° was registered at Loughborough, 73·5° at Henley-in-Arden, 73·0° at Hodsock and Coston Rectory, and 72·4° at Strelley. In the rays of the sun, 127·6° at Strelley on the 6th, 126·4° at Loughborough on the 3rd, 124·3° at Hodsock on the 5th. The minima were lower than for some years past, the thermometer recording 28·0° at Coston Rectory and 28·7° at Hodsock on the 26th, 30·0° at Henley-in-Arden and 30·4° at Loughborough on the 28th, and 30·2° at Strelley on the 26th; on the grass, 22·9° at Hodsock and 24·7° at Strelley on the 26th, and 28·7° at Loughborough on the 28th. Rainfall was excessive in the South Midlands, the total values being 3·44 inches at Loughborough, 3·37 inches at Henley-in-Arden, 3·11 inches at Strelley, and 2·89 inches at Coston Rectory; at Hodsock, in North Notts, the total was only 1·77 inches. Heavy falls occurred on the 10th; 0·95 inches at Henley-in-Arden, 0·94 inches at Loughborough, and 0·71 inches at Coston Rectory. The number of "rainy days" varied from 19 to 21. A slight fall of snow occurred at Coston Rectory on the 25th. Sunshine was decidedly above the average. Lightning and thunder were observed at Loughborough on the 3rd and 6th, a solar halo on the 16th, and a lunar halo on the 24th.

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Natural History Notes.

The British Moss Flora, Part IX.—We are pleased to see this part of Dr. Braithwaite's great work. It will be greatly valued by British bryologists. It contains four plates, with illustrations of twenty-five species. In the text, descriptions are given of fourteen species of *Tortula*, *Pleurochæte squarrosa*, and fifteen species of the comprehensive genus Mollia.

Mr. Clement L. Wragge has been commissioned by the Queensland Government to visit and report "as to the best means of establishing Meteorological Stations in Queensland, including Cape York Peninsula and Torres Straits." Mr. Wragge, who lately returned from a scientific expedition on his own account to North Queensland, commenced this important work early last month, and expected to reach Normanton, in the Gulf of Carpentaria, about the 15th October.

New British Fungi.—Some time ago I mentioned the discovery of the first species of Mortierella recorded as growing in Britain; it was allied to *M. tuberosa*, but I was unable to complete the identification owing to the paucity of the material. I afterwards found a second species, *M. Candelabrum*, in larger quantity, and have just now been gratified to find another species of this beautiful and curious genus, *M. polycephala*, Coemans. This has occurred in great quantity on damp Sphagnum and other mosses. I have also lately met with *Helminthosporium hormiscioides*, and *Fusidium lycotropum*.—W. B. Grove, B.A.

Ejected Pellet of a Robin.—On the 4th of October a cock robin alighted upon the grass about three feet from my breakfast room window. He stood there quite still for a minute or two, facing me as I looked out. I noticed a convulsive movement in his throat, and presently he opened his beak wide, as if gaping, shook his head smartly, and there fell out of his mouth a worm about 1½in. long, and a black substance rather smaller than a horse-bean. The robin picked up the worm again in his bill and flew away with it. I went out to examine the black object which he had left behind, and found it to be a pellet of hard fragments half-an-inch long and a quarter of an inch thick. On macerating this pellet in water it was found to consist of fragments of beetles and flies, the legs, broken elytra, wings, jaws, heads, &c.; also the skin of a caterpillar three-quarters of an inch long, and small green particles of vegetable matter, some of which were inside the skin of the caterpillar and may have formed the food of that creature, and not of the robin. There were, however, fragments of grass a quarter of an inch long, not inside the caterpillar, but these may have been taken up accidentally with worms.

F. T. Mott.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, September 29th. Mr. T. Bolton exhibited some galls on the petals of the leaves of the poplar from Selly Oak, and *Stemonitis fusca*, one of the Myxomycetes; and, on behalf of Mr. Cecil Davies, some pupa cases from South America. Mr. W. B. Grove, B.A., exhibited the following fungi:—*Pestalozzia* *longiseta* on Azalea leaves (new to Great Britain), found at Sutton Coldfield; also *Agaricus jubatus* and *Phragmidium violaceum* from Barnt Green. Mr. A. Browett made some interesting remarks about the late meeting of the British Association at Aberdeen.—GENERAL MEETING, October 6th. The President made a few remarks upon the work done by the Society during the past session, and he expressed a hope that more of the members would attend the meetings in the future, and suggested that the meetings might be made more attractive and enjoyable to the ordinary student if the subjects were treated in a more popular and less technical manner, at the same time not to interfere with the specialist; that an account be kept of the various excursions, work done, specimens obtained and verified, and any other information, such account to be entered in a book to be called the log-book of the Society's excursions, and that the record of each excursion should be read at the next meeting following. He thought this course, if adopted, would add materially to the interest of the meetings and prove a valuable source of reference. Mr. T. Bolton exhibited oak spangles (galls) made by the insect *Cynips longipennis;* Mr. Saunders, an entomostracon; Mr. J. Levick, *Zoothamnium arbuscula* and *Cordylophora lacustris;* Mr. J. Morley, the male Gall Fly (*Trypeta cardui*) and the Horned Ichneumon Fly (*Eulophus nemata*), both mounted without pressure. Mr. J. T. Blakemore, live foraminifera from Aberystwith; Mr. J. Edmonds, the bush spider; Mr. W. P. Marshall, a flower of lobelia; Mr. C. Pumphrey, beaded hairs in the flower of the pansy; Mr. Cecil T. Davies, skulls of British birds; Mr. A. Browett, *Lycopodium clavatum*, from Scotland; Professor C. Lapworth, a number of geological charts and maps of the Birmingham district, prepared by the students attending his lectures at the Mason College. Mr. J. Rabone exhibited some objects, kindly lent by Mr. W. Spencer, Regent's Place; the first in point of interest was a part of a carbonised branch of a coniferous tree, found at a depth of 195 feet below the surface in the Kimberley diamond mine in South Africa. The branch had been converted into a brittle lignite, and adhering to it was a portion of the rock in which it had been embedded, and upon the surface was to be seen a small diamond *in situ*, about as large as a grain of wheat. He also showed a number of shells of the Avicula or pearl oyster, and portions of others which had been cut by the button lathe. The origin of the pearl is due to the presence of some foreign substance within the shell, which the oyster, not having the means of extruding, covers over with nacre, of which the pearl is composed; specimens were shown which (the pearls being split) exhibited the bodies of small crabs perfectly preserved; a portion of the case of *Terebella* was seen to have been enclosed, and other pearls had been formed over small stones. A number of small pearls, of a dullish yellow appearance, taken from the common oyster, and others of a darker hue from the common mussel, were also shown. Mr. R. W. Chase exhibited the following birds:—*Muscicapa atricapilla*, Pied Flycatcher, male, female, and young, Ebchester; *Locustella nævia*, Grasshopper Warbler, young, in two stages, near Newcastle; *Serinus hortulanus*, Serin Finch, adult, Yarmouth, 14th June, 1885; *Lanius pomeranus*, Woodchat Shrike, adult male, Yarmouth, 16th May, 1885; *Ægialitis cantiana*, Kentish Plover, female, Breydon Flats, 8th May, 1885; *Phalaropus hyperboreus*, Red-necked Phalarope, male, and young in down, Shetland, 11th July, 1882; *Strepsilas interpres*, Turnstone, male, Breydon Flats, 14th May, 1884; *Numenius phæopus*, Whimbrel, in the down, Hascosea, 3rd July, 1882; *Stercorarius catarrhactes*, Common Skua, Shetland, 10th July, 1882; *Stercorarius crepidatus*, Richardson's Skua, adult female, showing light and dark forms. —BIOLOGICAL SECTION, October 13th. Mr. W. P. Marshall in the chair. Mr. J. E. Bagnall, A.L.S., read a paper on the "Flora of the Anker Basin," in which he gave an account of the course and drainage of the Anker, the physical features of the country, the number of plants he had found, their classes of citizenship, geographical distribution, and also compared the flora of the Anker with that of the Blythe. The paper was illustrated by microscopical preparations and numerous specimens, among which were *Didymodon flexifolius*, *D. luridus*, *Sparganium neglectum*, new to North Warwick, and other rare specimens. He also handed in full lists of the flowering plants and mosses of the Anker district. Mr. T. Bolton, F.R.M.S., exhibited for Mr. Blakemore winged aphides, species not determined. Mr. W. Spinks, of the Royal Nurseries, Edgbaston, exhibited a living specimen of a large green grasshopper, which is supposed to be a South American species, introduced with some bulbous plant. Mr. Bagnall, for Mr. Henry Groves, *Liparis loeselii*, a very rare plant from Norfolk. Mr. W. B. Grove, B.A., gave an account of his visit to the Woolhope Fungus Foray, and exhibited a number of fungi from Hereford and the Sutton district, among others *Lactarius vellereus*, *L. torminosus*, *L. mitissimus*, *Ag. Badhami*, *Ag. rhacodes*, *Ag. fusipes*, *Ag. nudus*, *Ag. grammopodius*, *Ag. pisciodorus*, *Ag. hæmorrhoidarius*, *Geaster Bryantii*, *Bovista nigrescens*, *B. plumbea*, *Lycoperdon gemmatum*, *Cortinarius ochroleucus*, *C. mucifluus*, *Cantharellus tubæformis*, *Hirneola auricula-judæ*, *Boletus laricinus*, *Polyporus annosus*, all from Hereford; *Ag. pseudo-purus*, *Ag. butyraceus*, *Ag. dryophilus*, *Ag. rubescens* (without scales), *Ag. galopus* var. *candidus*, *Ag. leucogalus*, *Ag. metachrous*, *Ag. carcharias*, *Cortinarius tabularis*, *C. saturninus*, *Marasmius peronatus*, *Lactarius glyciosmus*, *Ag. asterosporus*, *Russula emetica*, *R. ochroleuca*, *R. citrina*, all from Little Sutton and Bradnock Hayes; *Ag. cirrhatus* (with *Stilbum vulgare*, on decayed *Lactarius deliciosus*), *Boletus flavus*, *Ag. terreus*, *Ag. inamœnus*, from Sutton Park; *Niptera Riccia*, new to Britain, *Dendrodochium citrinum* (sp. nov.), and *Actinonema Rosæ* (in good fruit), all from Sutton; and *Diplodia hederæ*, new to Britain, from King's Norton. Mr. W. H. France, the cardoon, *Cynara cardunculus* (?), a beautiful thistle, first noticed as a cultivated plant by Parkinson, 1629; it is esculent, and has the power of coagulating milk.—MICROSCOPICAL GENERAL MEETING, October 20th. Dr. A. M. Marshall presented to the Society a copy of a new edition of his work upon the frog. Mr. W. B. Grove, B.A., exhibited *Helicosporium lumbricoides*, Sacc. (new to Great Britain), *Tetraploa aristata*, B. and Br. (very rare), *Helotium scutula* var. *Lysimachiæ*, Phill., all from near Sutton; *Coniothyrium concentricum*, *Coremium vulgare*, and *Triposporium elegans*, from Hereford; also, to illustrate Mr. Grattann's paper, the following sea-weeds:—*Cladophora rectangularis* and *Polysiphonia elongata* (in fruit). Mr. W. H. Grattann's paper was then read upon "The irregularity of appearance of some species of marine algæ." After the paper a discussion took place, in which several of the members joined.—SOCIOLOGICAL SECTION. At the ordinary meeting, held on Thursday, 15th October, the President (Mr. W. R. Hughes, F.L.S.), delivered a brief address, in which he alluded to the satisfactory progress of the Section and to several interesting matters connected therewith. Mr. W. B. Grove, B.A., ably expounded Chapters I., II., and III. of Part IV. of Mr. Herbert Spencer's "Principles of Biology," Vol. 2, on "The Problems of Morphology and on the Morphological Composition of Plants." The President was unanimously requested to write a letter to Mr. Herbert Spencer, congratulating him on the appearance of a third edition of Vol. I. of "The Principles of

Sociology," and on the completion of Part VI. of that work on "Ecclesiastical Institutions." On Saturday, the 17th October, the members of the Section and other friends, to the number of nearly fifty, paid a second visit to George Eliot's country, and were, by the kindness of C. N. Newdegate, Esq., M.P. (who personally conducted them over the building), allowed to see Arbury Hall, the Cheverel Manor of Mr. Gilfil's love story; after which they drove to South Farm (the Hall Farm of Adam Bede), and from thence to Coventry, where a substantial tea was served at the King's Head Hotel. After tea, some opening remarks were made by the President (Mr. W. R. Hughes) with reference to the early association of Mr. Herbert Spencer with George Eliot, and the mutual influence for good each had had on the other; after which Mr. W. Showell Rogers, M.A., LL.M., delivered a most interesting address on George Eliot's works. Thanks were voted to Mr. Showell Rogers for his address, and also to Mr. C. N. Newdegate, M.P.; and to Mr. Alfred Browett, hon. sec. of the Section, for the able manner in which he had organised the excursion.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 19th. A visit was made, by invitation, to Warley, to inspect the geological collection of Mr. Holden. The specimens were very numerous, and comprised fossils, &c., from nearly all formations. A hearty vote of thanks to Mr. Holden for his kindness brought a pleasant afternoon to a close.—September 21st. Mr. H. Insley exhibited a polished slab of chain coral from the Rushall Canal; Mr. Hawkes, the following fungi:—*Xenodochus carbonarius* and *Sphærotheca castagnei*, both on Great Burnet; *Uromyces intrusa*, *Cystopus candidus*, *Phragmidium mucronatum*, *Puccinia lychnidearum* and *Uromyces ulmariæ*, the latter on *Rosa canina;* Mr. Moore, internal shells of *Limax flavus;* Mr. J. A. Grew, a male specimen of convolvulus hawk moth, *Sphinx convolvuli;* Mr. Evans, *Aviculopecten papyraceus* from the Gannister beds, Staffordshire, and native copper from Lake Superior. Under the microscopes, Mr. Tylar showed eggs of *Scatophaga stercoraria;* Mr. Hutchinson, *Paludicella Ehrenbergii;* Mr. J. W. Neville, head of Phalangium; Mr. Hawkes, conceptacles of hop mildew, *Sphærotheca castagnei.*—September 28th. A discussion on "The Ice Age" was opened by Mr. Rodgers reading a paper that explained the theory of Lieut.-Col. Drayson that the earth's axis moving in a circle round a centre six degrees removed from the pole of the ecliptic brings about a great change in the obliquity of the earth's axis, and thereby brings the poles more under solar influence in the summer, and, in the winter, by bringing down the arctic circle to a low latitude, the result is a hot summer and severe winter each year. This polar movement is completed every 31,000 years. To the ice accumulated during the winter and removed each summer for 16,000 years is attributed the glaciation of Europe and elsewhere. The discussion was adjourned.—October 5th. Mr. Madison exhibited specimens of *Helix pulchella* var. *costata* from Minworth; Mr. Hopkins, *Helix aspersa* var. *albofasciata;* Mr. C. F. Beale, a specimen of long-eared bat, *Plecotus auritus*, also a series of photographs of microscopical objects; Mr. Hawkes, the following fungi:—*Trichobasis oblongata*, *Puccinia bullaria*, *Sphærotheca pannosa*, and *Uncinula bicornis*, the latter under the microscope. The discussion on "The Ice Age" was continued by Mr. H. Insley explaining the well-known theory of Dr. Croll.—October 12th. Mr. Hopkins exhibited specimens of *Paludina contecta* and *Helix aspersa* var. *unicolor;* Mr. Madison, *Helix pomatia* and very young specimens of the same; Mr. Moore, *Helix relevata* and *Achatina acicula.* A paper was then read by Mr. Evans on "The Drift," which described superficial layers and the extent to which they were formed of older rocks. The Moseley drift was particularly dealt with, as being the chief field of the writer's labours. The paper enumerated the different rocks found there, and also the fossils contained in them, comprising specimens of *Rhynchonella, Lingula, Orthis, Pentamerus, Meristella, Spirifer, Aviculopecten,* crinoidal stems, worm tracks, fragments of Trilobites and Lepidostrobus. The fossils bearing a strong resemblance to those of the Bunter beds, the writer held that the drift was a redistribution of those pebbles, and that they were originally derived from an old land barrier running across central England, some outlines of which were pointed out. The writer, in conclusion, hoped to be able at a future time to give some results of work in the Bunter beds, by which he hoped further light would be thrown upon this question. The paper was rendered additionally interesting by an exhibition of the fossils referred to.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.— Monthly meeting, Wednesday, October 21st. Attendance twelve (four ladies). It was announced that the following three members of the Society had joined this section, viz.: Dr. Tomkins, R. Overton, Esq., and A. G. Turner, Esq., B.A. Arrangements were made for a fungus foray to Swithland Wood, &c., on Wednesday, the 28th October, at which Dr. Cooke, of London, had promised to assist. A covered brake to start from the Bell at 10 a.m. The following objects were exhibited by various members, viz.: By Mr. Grundy, a set of microscopic slides of entomological subjects, prepared by himself without pressure, the cells being made of a ring of tin with several slight grooves filed across to allow the escape of air bubbles; by Miss Grundy, a box of very small and delicate shells, chiefly *Pecten,* from the sea shore; leaf and abortive panicle of *Rhus cotinus,* the wig tree; leaf of the camphor laurel, *Laurus camphora;* and a well-executed drawing of a longitudinal section of the fruit of *Rubus fruticosus* var. *laciniatus,* × 4; by Mr. F. Bates, a slide of the remarkable alga, *Bulbochæte mirabilis,* found on submerged leaves of *Ranunculus aquatilis,* near Narborough, and new to the county; also living clusters of desmids (*Cosmarium*) in water, with prepared slides for the microscope; by Mr. E. F. Cooper, a branch of *Rhamnus catharticus,* with abundance of ripe fruit; by Miss Noble, a fruiting branch of an almond tree; by Miss Iöns, leaves of the Canadian scarlet oak in their autumnal colour; by the Chairman, specimens of the grass called "onion twitch," *Arrhenatherum avenaceum* var. *bulbosum,* showing the knobs at the base of the stem; and a sunflower, *Helianthus annuus,* of unusual size, 11in. across the disk, 16in. across the ray, weighing 3lbs. The plant from which it was cut was 9ft. 3in. high, with a stem 1¼in. diameter, and leaves 16in. broad. Mr. Thomas Carter, LL.B., read a paper on "Some Alpine Plants of Britain," illustrated by mounted specimens of about forty species out of the hundred which belong to the Arctic flora, and by a series of maps showing the distribution of these species over the globe and in the British Islands, and discussing the different theories which have been suggested to account for their isolated occurrence on the summits of various mountain ranges. Mr. F. Bates read a short description of the fresh-water alga, *Bulbochæte mirabilis.*

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Exposition of Chapter XII.—On "Distribution."

BY WILLIAM MATHEWS, M.A., F.G.S.

In studying the distribution, on the earth's surface, of any group of organisms, two facts, of widely different significance, are presented to our attention. First, the character of the inhabitants of any given locality depends upon the nature of the locality; secondly, two localities approximately similar in nature will, if sufficiently far apart, be tenanted by different collections of organisms; the species inhabiting them will, as a general rule, be representative and not identical.

In the remarks which I am about to offer on the subject of distribution, I propose to examine briefly some of the leading phenomena presented by the distribution in space of flowering plants.

The habitats of such plants are characterised by one or more of the following variations and conditions:—

(A.)—Differences of land and water—
- Marine.
- Fresh water.
  - Stagnant.
  - Running.
- Marsh.
- Land.
  - Littoral.
  - Inland.

(B.)—Differences of soil—
- Calcareous.
- Argillaceous.
- Siliceous.

(C.)—Differences with respect to cultivation or otherwise—
- Meadows, Pratal.
- Pastures, Pascuál.
- Arable land, Agrestal.
- Heaths, Ericetal.
- Road sides, Viatical.
- Hedges, Septal.
- Woods, Sylvestral.
- Rocks, Rupestral.

(D.)—Differences of climate—
- Latitude.
- Extreme temperatures in summer and winter.
- Altitude.
- Humidity.

(E.)—Differences arising from the presence or absence of other plants.

(F.)—Differences arising from the presence or absence of certain animals and especially of insects.

Influences of the above nature are called by Herbert Spencer "Negative." What is meant is that the absence of one or more of the above conditions will determine the absence of any given plant, but the presence of those conditions will not necessarily determine the presence of such plant. We are thus led to the consideration of the second of the main facts of distribution, viz., that similarity of conditions is frequently accompanied by great dissimilarity of Fauna and Flora.

The explanation is that the Fauna and Flora of any area on the earth's surface is derived from that which immediately preceded it in time, and that similar variations of condition acting on dissimilar organic materials have produced dissimilar results. The earth's surface has been in a state of continuous modification throughout past ages, and corresponding modifications have occurred in its organic inhabitants. The present phenomena of distribution are the result, and their study enables us to read more readily the past history of the earth.

Before the distribution of plants can be used as a key to that history, we must understand the various means by which distribution is effected or we may fall into serious error.

1st.—A number of plants are distributed all over the world by the agency of man. They are generally of intense vitality, of very unprepossessing appearance, and not only of no economic value but great hindrances to cultivation. Such are the thistle, dock, and nettle, and other noxious weeds. The way in which these plants colonise a foreign country may be seen by a glance at the Flora of New Zealand. The Canterbury Province in the Southern Island contains 750 native phanerogamous plants. Within the last twenty years 250 European species (one third in number of the indigenous Flora) have been introduced. They are, many of them, English weeds, and are increasing with such rapidity as to threaten the native plants with extirpation.

2nd.—Another group, generally fresh-water species, are widely dispersed by the agency of birds. For an illustration of this phenomenon we may again refer to the New Zealand Flora. Twenty-two of the native plants of the Canterbury Province are common English species, and of these eighteen are fresh-water and three littoral forms.

3rd.—Another group, chiefly littoral forms, are dispersed by the agency of ocean currents.

4th.—Allowance having been made for the three preceding modes of dispersion, there still remain a large majority of which the only explanation that can be given is that they have travelled over continuous land. It is to these that we must look for information as to the former oscillations of land and water.

Before leaving the New Zealand Flora it will be interesting to note some remarkable features which it presents and which show the extreme differentiation of an insular Flora, as distinguished from a continental one. Of the 750 flowering plants in the Canterbury Province, 538 are restricted to New Zealand. The number of genera of flowering plants and ferns is 275, and of these no fewer than 109 have only one species each. Of 857 species of flowering plants and ferns, 176 are Australian and 108 American, showing former connection with these continents, but very long separation.

The history of the more recent geological changes in its bearing upon the distribution of plants on the European Continent is of the highest interest. We know, from the evidence of their fossil remains, that in Miocene times a large assemblage of plants of a tropical or sub-tropical character covered the land of the northern hemisphere from the Tropic of Cancer to within ten degrees of the Pole. Palms, figs, and laurels grew on the site of the Lake of Geneva, and the plane, tulip-tree, walnut and vine, together with the Sequoia and Magnolia, flourished in Greenland. After Miocene times there was a gradual decline of temperature, which culminated in the refrigeration of the glacial epoch, and this again has been succeeded by the climatic conditions of the modern world. Simultaneously with these variations of temperature were oscillations in level of many thousand feet, and corresponding changes in the boundary of sea and land. Now consider what must have taken place as the climate gradually became colder. The plants in any given zone of latitude would be sorted by the increasing cold. Those unsuited to the colder climate would be driven to the zone below, where they would find their proper temperature, but be subjected to new conditions of various kinds. The hardier species would remain behind, but their interactions would be changed and they would be affected by migrations from the zone above. The effect would be a migration southwards of a vast numbers of species. When the European stream reached the foot of the Alps it would divide into two branches, the one travelling into France and Spain, the other into Hungary, Turkey, and the Levant. At the same time with these migrations the Alpine species would descend from the mountains into the plains. As the climate grew warmer the migrations would continue but their direction would be reversed. The southern species would return northward, the Alpine species would travel partly to the mountain summits, partly to the Arctic zone. During the glacial epoch there was a great submergence, by which many of the plants of northern Europe must have been destroyed. These changes must have produced large specific modifications in the European Flora, and account for many of the singular phenomena of distribution which it presents.

We observe, for instance, striking differences between the Floras of the east and west end of the Alps, small groups of remarkable species restricted to areas of very limited dimensions, single species appearing in a few spots widely distant from each other, such as the Welsh Poppy in Wales, Central France and the Pyrenees, or restricted even to a single locality, as *Wulfenia carinthiaca* to one mountain in the eastern Alps. On the other hand, we find plants restricted to a few localities, but very widely distributed, strangely incapable of colonising the intervening spaces, even when provided with the feathery pappus of composites, such as *Hypochœris maculata*, and some of the Hawkweeds. Finally we have the Alpine Flora, characteristic of the higher summits of the Pyrenees, Alps, Carpathians, Altai, and Caucasus, and reappearing to a great extent both in the Old and New World, within the Arctic zone.

The origin of this Flora and the nature of its connection with that of the Arctic zone is a question of great interest which has been discussed with signal ability by Mr. John Ball.* Sir J. D. Hooker was of opinion that the Alps had been colonised from the Arctic regions; Mr. Ball, with more justice, as it seems to me, holds the view that the Arctic regions were colonised from the Alps.

The genus most characteristic both of the Alps and Arctic regions is certainly the saxifrage. Its distribution in Europe

* Proceedings Royal Geog. Soc., New series, vol. 1, p. 564.

is as follows:—The Scandinavian species are fourteen in number. Of these all but two are in the Alps, all but four in the Pyrenees, and almost all are North American. The Alpine saxifrages number forty-four, of which twelve only are Scandinavian, while twenty-five are Carpathian, twenty Pyrenean, and eight Altaic.

Mr. Ball points out that of 1,157 species characteristic of the Alpine Flora, two-thirds are found in the Carpathians, one-half in the Pyrenees, and one-fourth in the Altai.

When we pass to the south of the Mediterranean the contrast is amazing, the entire Algerian Atlas yielding seven species only of Alpine plants.

The Flora of our own country, although of comparatively small interest, owing, as I believe, to the destruction of the greater part of the indigenous plants at the time of the submergence in the glacial age, presents, nevertheless, some curious features.

The total number of species is 1,665; of these, 1,465 are Germanic or Scandinavian, the majority of which are scattered over the whole of northern temperate Europe and Asia.

They may be subdivided into plants widely spread in Britain, Germanic plants confined to the eastern side of England, mountain plants (Scandinavian or Alpine).

Deducting aliens and uncertain segregrates, we have left 119. Of these, 114 are species belonging to south-west Europe and three are American. It is worthy of remark that there does not exist throughout the whole extent of the British Isles a single well-defined endemic species.

A few words upon one of the most curious points connected with the distribution of plants, and these remarks must be brought to a conclusion. I refer to the contrast which different genera present in their capacity for receiving specific modifications under the influence of varying external forces. On the shores of the Mediterranean the bramble is almost stable; the only form that is met with, or nearly so, is *Rubus discolor*. In the northern part of temperate Europe its variations are very numerous. On the other hand, the genus *Medicago* is nearly stable in the zone of *Rubus*, and highly plastic on the Mediterranean coasts. *Astragalus* presents differences still more remarkable than those of *Medicago*. In England there are only three species, in France twenty-four, in Spain thirty-nine; while Boissier, in his "Flora Orientalis," including only the extra-tropical countries from Greece to the borders of India, enumerates no fewer than 757 species.

ANTHROPOLOGY, ITS MEANING AND AIM.

BY JOSEPH SMITH, JUN., M.A.I.

(Continued from page 325.)

The change of climate to mildness has a tendency to reduce the size of the body, and it will be found on comparison that the bones from the early sepulchres, when a cold climate has been known to exist, are of greater proportions than those of beings dwelling in the same place during a warmer temperature.

The skull of an infant is soft, and is capable of being moulded into any form before solidifying takes place. If consideration is taken of the innumerable and adventitious causes which come into operation, and influence the formation of the skull, you will no longer be able to wonder at the variety of form presented by the human cranium, even amongst those belonging to our own nation. Sleeping on the back gives a compressed occiput, and by lying on one side you have an elongated skull. Hippocrates ("De aer., aqu., et loc.," 35,) states that after artificial shaping of the skull has taken place for a very long period, a kind of natural degeneration is observed, and the means previously adopted for obtaining this form are no more a necessity, since the skulls grow of their own accord to the form acquired.

Anthropologists have been labouring strongly to establish some recognised method of measurement, the result of which is that Retzius's division has been further divided and improved, the skull indices for the measurement of capacity being as follows :—

Length and Breadth Index.

$$\frac{100 \times \text{breadth}}{\text{length}}$$

Dolichocephalic (long skull)	below 75·0
Mesocephalic	75·1 to 79·9
Brachycephalic (short skull)	80·0 „ 85·0
Hyperbrachycephalic	85·1 and over.

Length and Height Index.

$$\frac{100 \times \text{height}}{\text{length}}$$

Chamæcephalic (flat skull)	75·0 and under
Orthocephalic	70·1 to 75·0
Hypsicephalic (high skull)	75·1 and over.

PROFILE ANGLE.

This, which is the inclination of the profile line to the horizontal plane, is classed under the three following divisions :—

1.—Prognathous .... 82° and under
2.—Mesognathous, or Orthognathous......... 83° to 90°
3.—Hyperorthognathous .... 91° and over.

FACIAL INDEX—(*Virchow*).

$$\frac{100 \times \text{height}}{\text{length}}$$

The breadth of the face considered as the linear distance between the two jugo-maxillary sutures (as also the facial index of Von Holder).

Broad-faced skull .... 90·0 and under
Narrow-faced skull .... 90·1 and over.

INDEX OF THE UPPER FACE—(*Virchow*).

$$\frac{100 \times \text{upper facial height}}{\text{facial breadth}}$$

Facial breadth considered as a linear distance between the two jugo-maxillary sutures and the upper facial height.

Broad upper face.............. .... 50·0 and under
Narrow upper face .... 50·1 and over.

ZYGOMATIC FACIAL INDEX—(*Kollman*).

$$\frac{100 \times \text{facial height}}{\text{zygomatic breadth}}$$

The greatest distance between the zygomatic arches, and the facial height, divided into two classes.

Low-faced chamæprosopic skull, from προσωπον, meaning "face"............. .... 90·0 and under
High-faced leptoprosopic skull .... 90·1 and over.

ZYGOMATIC UPPER FACIAL INDEX—(*Kollmann*).

$$\frac{100 \times \text{upper facial breadth}}{\text{zygomatic breadth}}$$

Chamæprosopic upper face with an index of 50·0 and over.
Leptoprosopic upper face with an index of 50·1 and over.

The upper facial index acts as a control measurement to the facial index. It is important to ascertain it in cases where, through the absence of the lower jaw, the facial index cannot be determined.

ORBITAL INDEX.

$$\frac{100 \times \text{orbital height}}{\text{orbital breadth}}$$

Chamækonchous	80·0 and under
Mesokonchous	80·1 to 85·0
Hypsikonchous	85·1 and over.

NASAL INDEX.

$$\frac{100 \times \text{nasal breadth}}{\text{nasal height}}$$

Leptorhine	47·0 and under
Mesorhine	47·1 to 51·0
Platyrhine	51·1 ,, 58·0
Hyperplatyrhine	58·1 and over.

Palatal index of Virchow only provisional, and as yet is not adopted.*

Colour plays a great part in the natural history of man, and although it is not a subject I am here going to enter on, still a few words thereon may not be unacceptable. It is well known that white men, when dwelling for a considerable time in torrid zones, lose an amount of whiteness and assume a brownish tinge, sensibly verging to black, with much more facility; and there is ample mention in the observations of travellers that "on the black attaining his seventieth year" there is a great tendency to a lighter colour, for at that age the reticulum sensibly loses a portion of its colour, causing the hair and beard to assume at first a straw and then a white tinge; and infants brought to a colder climate while young lose a quantity of their black colour, and assume a tinge more approaching brown. Blumenbach, in his memoirs, states that he himself knew a mulatto woman, born of an African father and white mother, who in her youth was sufficiently brown, but who by a residence in a colder clime and through time, had so degenerated in this respect that she retained only a cherry or tawny-coloured skin; and he also asserts that a colony of Portuguese ("Rech. sur les Americ," i., p. 166,) who were carried to Africa in the fifteenth century, have now assimilated the native colour to such an extent as to be scarcely distinguishable from the aborigines. Thus it will be seen that climate is accountable to a great extent for the variation of colour tint in the different nations. The varieties will be apparent in

* These measurements are extracted from the remarks of J. G. Garson "On the Frankfort Craniometric Agreement" in the "Journal of the Anthropological Institute of Great Britain," vol. xiv., p. 66, &c.

the offspring of unions of different tints, and this principle may be accepted, that in these cases the more opposite and contrary colours so degenerate that white men may sensibly pass into black men, and the reverse. Hybridity, if such term may be applied to this feature of Anthropology, is, as seen from the foregoing, a very important principle, as by it such varieties of colour are attained; and a feature which must not be omitted is that the fecundity of the descendants of the issue of these hybrid unions is superior to that of men and women of the same colour, a circumstance which, in the economy of Nature, will in a period of time have much effect on the variety colour of a race. These offsprings are distinguished by class names, arranged by Blumenbach as follows:—

The issue of a black man and white woman, or black woman and white man, is called Mulatto, Molaka, and Meletta; in Italian, Bertin, Creole, and Criole; in the Malabar language, Mestico. The issue of an American man and European woman is a Mameluke, or Metif; from an European male and a Mulatto female comes a Terceron, Castiça. The son of an European female by a Metif is a Quateroon; the issue of two Mulattos is a Casque; and of Blacks and Mulattos, Griffs. A Terçeron female and European produce Quateroons, Postiços; and the American Quateroon (who is equal to the Black Terçeron), produces from an European, an Octavoon. The issue of a Quateroon male and a white female is a Quinteroon; and the child of an European woman from an American Octavoon is, in Spanish, Puchuela; and so as these various grades marry and intermix, the progress from lighter to darker, and *vice versa*, can very easily explain away some of the difficulties regarding the variation of colour. Then there must be considered those curiosities, if the term be allowed, which present themselves in all anthropological investigations, but which do not form any part of the present paper. I refer to spotted men, wild men, Leucæthiopians, Nyctalopes, &c. These offer interesting investigations, but their study belongs rather to the physiologist than to any other.

The preceding are some of the features or factors, which enter into and form part of that study which has for its object the investigation of the most perfect creature of the Creator. From these it will be seen how grand and extensive is the range of Anthropology, how broad is its meaning, and how ennobling is the aim of the science.

SOME INACCURACIES UPON THE GEOLOGICAL SURVEY MAPS AND SECTIONS OF THE LEICESTERSHIRE COAL-FIELD.

Having been in a position to verify portions of the one-inch Geological Survey maps and some of the vertical and horizontal sections of the coal district between Ashby-de-la-Zouch and Burton-on-Trent, I think the errors discovered in them should be made known, so that those interested in the geology of the locality may not be misled.

(a) Taking the *one-inch map* first, on quarter sheet 63, N.W.

i.—At one mile to the S.E. of Overseal village, where the word "Derbyshire" occurs, there is an exposure or out-crop of the Permian "brecciated conglomerate."

ii.—The Fault marked as running for a distance of nearly one mile from the E. end of the reservoir on Ashby Woulds in a N.W. direction is entirely wrong; the white line should have gone in a N.N.E. course from "Hanging Hill," near Moira, towards "Wooden Box" (Woodville, as the place is now usually called).

iii.—On quarter sheet No. 71, S.W., the Fault shown as running N.W. and S.E. at about half a mile to the E. of Swadlincote Railway Station is in reality only about a quarter of a mile from that station.

Other minor errors might be mentioned as having been made upon these two maps were it necessary to do so.

(b) Upon the *Horizontal Sections*, Sheets Nos. 49 and 52, I notice the following inaccuracies. Upon No. 52 in Section 2, the fifth Fault from the commencement of the Section in the W. is a downthrow to the W., and not to the E. as marked. On sheet No. 49 in Section No. 2, the Permian rocks shown about the middle of the Section near "Norris Hill" have not been coloured as such.

(c) With regard to the *Vertical Sections*.—Taking sheet No. 20 (Leicestershire Coal-field, Moira district).

No. 2 Section.—The water referred to as being large in quantity in certain of the strata does not naturally exist in the measures, but proceeds (or rather when the shafts of this colliery were sunk, proceeded) from old drowned-out main-coal workings situated to the S. or rise side of the "Oakthorpe New Colliery."

No. 3 Section.—For "Hastings and Grey Shafts," read "Newfield Shafts." (See No. 4 Section.)

No. 5 Section.—The following beds of coal have been omitted :—

At	23ft. 4in.	from the surface a coal		2ft. 2in. thick.		
At	78ft. 2in.	,,	,,	1ft. 8in.	,,	
At	120ft. 0in.	,,	,,	1ft. 1in.	,,	
At	125ft. 6in.	,,	,,	,, 5in.	,,	
At	167ft. 6in.	,,	,,	,, 5in.	,,	

As these five coal-beds were sunk through in the year 1821, they must have been either overlooked or accidentally left out when the Survey sheet was compiled.

No. 6 coal-seam of this (No. 5) Section is incorrectly given. The two uppermost beds bracketted under "over" should have been left out, the actual thickness of the seam of "main coal" being 12ft. 3in., not 14ft. 2in. as given.*

Nos. 6, 8, and 13 Sections.—The coal-seams named "Slate," "Woodfield," "Stockings," and "Eureka" should have been numbered 4, 3, 2, and 1 respectively in descending order.

No. 9 Section.—For "Mr. Healy," read "Mr. Eley."

W. S. Gresley, F.G.S.

MIDLAND UNION OF MICROSCOPICAL AND NATURAL HISTORY SOCIETIES.

At a Meeting of the Management Committee of the Union, held on Nov. 11th, it was resolved to accept the joint invitation of the Caradoc Field Club, the Oswestry and Welshpool Field Club, and the Shropshire Archæological Society, for the Meeting of the Union in Shrewsbury, in 1886. A central Executive Committee and Local Secretaries (the Revds. O. M. Fielden, of Oswestry, and T. Auden, of Shrewsbury) have already been appointed, and the Meeting in such an interesting town, with such a grand field for excursions, can hardly fail to be specially enjoyable. The exact date of the Meeting cannot be fixed at present.

It was also resolved that an attempt should be made so to modify the arrangements for the necessary business of the General Meeting as to make room for a few short papers on

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* The above particulars in reference to No. 5 Section are from the original account of the strata sunk through in the year 1821.

any subjects which may appear desirable. It was considered that by this means more particularly matters of interest in regard to the next day's excursions might be of service.

The Committee also had under its consideration the arrangements for the award of the Darwin Medal, which were referred to it for amendment by the Council at the Meeting last June. The paragraph which defines the papers eligible for the prize will now stand :—

"The Darwin prize is to be awarded to the paper, *or set of papers by the same author*, of highest merit which has been sent in since the expiration of the last term for which a prize was awarded for that subject."

Thus any paper, or set of papers in zoology, sent in between March 31st, 1882, and March 31st, 1886, will be eligible for the Darwin prize for 1886.

It will be seen that the alteration consists in inserting the words "or set of papers by the same author," doubts having arisen as to the powers of the adjudicators in this particular.

Another paragraph was adopted, viz. :—"The Council shall in any year withhold the Darwin Medal, in case the majority of the adjudicators report that the papers submitted to them are not of sufficient merit to deserve it."

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from page 285.)

The estimation of *distance* and *direction* of sounding bodies is a purely intellectual operation—the result of inference from intensity of sensation, &c.

The *perception of distance* and direction is only acquired by experience. Sensations of touch are localised only after multiform experience of the difference in the degree of the sensations excited in various spots. It is the same with hearing; we judge of the distance and direction of the sound by the kind of impression produced. If a sound is already known to us, as in the case of the human voice, we judge its distance by the feebleness of its impression upon the nerve of hearing. If the intensity at a given distance is unknown, as for example, thunder, we suppose it nearer according as it is louder. The rumbling of a waggon in the street is thus often mistaken for distant thunder, and *vice* *versa*. We thus see how inferential processes control our judgment of distance. If we are led to imagine a sound is farther off than it really is we seem to hear it stronger than it is. Awaking suddenly in the night we hear a faint noise and suppose it much louder, through our temporary confused notion of its real distance. Hence the slight creak of a part of the bed or bed room furniture, the gnawing of a mouse or beetle, &c., originates in timid and imaginative subjects ideas of ghostly and burglarious sounds.

It being an effect of distance that sounds fade away into a feeble hum, when we encounter a sound whose natural quality is feeble, like the hum of a bee, we readily imagine it more distant than it really is. Hence also the possibility of ventriloquism. The ventriloquist modifies his voice to imitate sounds proceeding from varying distances and places, and also tends to impose upon our judgment, through the effects of imagination, by directing his voice to various points, pretending himself to hear the sounds proceeding from thence. Must we then implicitly "believe our own eyes and ears"?

Our estimation of *direction*, according to our present knowledge, appears to be owing to a process of reasoning applied to the sensation. Thus we hear distinctly a sound emanating from a given point, whatever position the head is in; but, the ear being able to judge of slight differences in the intensity of sounds, we remark that in certain positions of the head the sound seems strongest. We are hence led to place our head in one fixed position as regards the sounding body—that is, the one which shall bring the external meatus as nearly as possible in a straight line with the sounding body. Our sight tells us what is this direction of most perfect hearing, and we then apply the observation made upon bodies that we can see to those that are not seen. The combined action of the *two ears* also favours very materially the perception of direction of sound—as our two eyes do visual perceptions. A person deaf in one ear is usually unable to say whether a sound proceeds from before or behind. According to Weber, in determining the direction of sounds we employ the external ear for those coming from above, below, behind, before; and the tympanum for those coming from left to right. He inserted the head in water, the air passages being filled with air so that the tympanum was free to vibrate, and found that in that case the ear recognised sounds as external, but could only distinguish them as proceeding from the right or left. When, farther, the ear itself was filled with water, and the free action of the tympanum arrested, the sense of externality was quite lost, and the feelings of sound regarded as subjective.

The sense of direction is by no means very delicate, even after being educated to the full. We can readily recognise whether a voice at about the level of our ears is before or behind, to the right or left, up or down; but if we were to stand opposite a row of persons at a distance of, say, ten feet, we should not be able to say, unassisted by sight, &c., which one uttered a sound, as schoolmasters well know. So it is almost impossible to find out a skylark in the air from the sound of its song. A simple experiment illustrating the uncertainty of our sense of direction of sounds may be performed by blindfolding a person seated in a chair, and clicking two coins opposite various parts of his body within reach of his arms, requiring him to point to the exact locality whence the sound proceeds. Some people will be found to eer greatly in their estimates. In his opening address, at the recent meeting of the British Association, Lord Rayleigh remarked upon the imperfect state of our knowledge of the means whereby we recognise the direction of sounds, and stated that it has been proved that, when proper precautions are taken, we are unable to distinguish whether a pure tone, as from a vibrating tuning-fork held over a suitable resonator, comes from before or behind, as might have been expected from an *à priori* point of view, but, what would not have been expected is, that with almost any other sort of sound, from a clap of the hands to the clearest vowel sound, the discrimination is not only possible, but easy and instinctive. In these cases it does not appear how the possession of two ears helps, though there is some evidence that it does; and even when the sound comes to us from the right or left the explanation of the ready discrimination which is then possible with pure tones is not so easy as it first seems. We should be inclined to think that the sound is heard much more loudly with the ear turned towards it than with the ear turned from it, and that in this way direction is recognised; but if we try the experiment we find that, at any rate with notes near the middle of the musical scale, the difference of loudness is by no means so very great. The wave-lengths of such notes are long enough in relation to the dimensions of the head to forbid the formation of anything like a shadow in which the averted ear may be sheltered. In such cases I should myself be inclined to look for the power of discrimination rather in slight qualitative differences in the effect of given stimuli according as they affect more directly the right or left branch of the auditory nerve, but I am fully aware of the objections which may be urged to this, and simply quote it as a surmise. The localising of the sensation I think, with Bain, to be due to the distinct central endings of the nerves from the two ears. In his words "Given the nerves distinct, sensations may be absolutely identical as feelings and yet quite distinct for intellectual purposes" [owing to their connection with different brain cells].

The diffused bodily movements and sensations frequently accompanying irritation or excitement of the auditory nerve, *e.g.*, the sudden start, winking, and general shock somewhat like that produced by an electrical discharge, caused by an intense and sudden noise, the thrilling grating sensation in the teeth, and cold trickling feeling caused by such sounds as those produced in saw sharpening, &c., may be adequately explained by the results of antipathies, and the operation of what Herbert Spencer calls the law of nervo-motor-action, which states that every feeling (including sensation) has for its primary concomitant a diffused nervous discharge which tends with varying degrees of force to excite the muscles to action, the degree and extent of energy in the resulting bodily movements varying directly as the intensity of the feeling, and affecting the muscles of the body in the inverse order of their sizes and the weights of their attachments. The pain caused by certain sounds seems again explicable, as is that accompanying other sensations, by excessive nervous stimulation, or wasting conflict between adverse nervous currents.

METEOROLOGICAL NOTES.—OCTOBER, 1885.

Atmospheric pressure was very variable during the month, and the changes numerous and rapid. The highest morning reading was on the 17th, 30·189 inches; the lowest, on the 26th, 29·027 inches. The mean temperature was about four degrees below the average. The highest maxima were 62·4° at Loughborough, on the 16th; 60·0° at Henley-in-Arden, on the 3rd, 8th, and 17th; 59·0° at Coston Rectory, on the 1st and 16th; 57·9° at Hodsock, on the 2nd; and 57·0° at Strelley, on the 3rd. In the rays of the sun, 115·1° at Hodsock, on the 5th; 113·8° at Loughborough, and 104·7° at Strelley, on the 3rd. The lowest minima were 25·0° at Coston Rectory, on the 12th; 27·3° at Hodsock, 29·3° at Loughborough, 30·5° at Strelley, on the 30th; and 31·0° at Henley-in-Arden, on the 12th and 30th. On the grass, 20·2° at Hodsock, 21·8° at Strelley, and 26·4° at Loughborough, on the 30th. The rainfall was unusually heavy, the totals being 6·34 inches at Coston Rectory; 6·01 inches at Strelley; 5·62 inches at Loughborough; 5·32 inches at Hodsock; and 4·51 inches at Henley-in-Arden. These values were distributed over from 21 to 24 days. The amounts measured in 24 hours were exceptionally large, particularly on the 23rd, when 1·67 inches were registered at Hodsock; 1·56 inches at Strelley; 1·54 inches at Coston Rectory; and 1·24 inches at Loughborough; 0·75 of an inch at Henley-in Arden, on the 6th. Sunshine was about the average. High winds prevailed generally through the month.

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THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(*Continued from page 295.*)

CRYPTOGAMIA.

ACOTYLEDONS.

FILICES.

POLYPODIUM.

P. vulgare, *Linn.* *Common Polypody.*
Native : On mossy banks, on the branches of old trees, and rarely on old walls. Locally common. June to October.
I. Sutton Park; Coleshill Heath; lanes about Maxtoke and Fillongley; Marston Green, Olton Lane; lanes about Knowle, Solihull, Honiley, Shirley, and Hockley; Forshaw Heath.
II. On a bank near Meriden Church, *Kirk*, *Phyt.*, ii., 809; near Norton Lindsay, *Perry*, *Phyt.*, i., 510; lanes about Allesley; Corley; Tile Hill; lanes about Baddesley Clinton; Rowington.

OSMUNDA.

O. regalis, *Linn.* *Royal or Flowering Fern.*
Native : In bogs and on river banks. Very rare. July.
I. Moist banks by the new park, Middleton, *Ray*, *Gough's Camb.*, ii., 350; bog at Coleshill Pool, *Bree*, *Purt.*, ii., 518.* Found formerly at Coleshill Heath and other places, but I cannot find it now. Sutton Park, as I am informed, but very sparingly, *Bree*, *Phyt.*, i., 511. Extirpated in Sutton Park many years since. It has been recorded from near Marston Green and by the Blythe, near Coleshill, but on uncertain authority.

* "It must be near thirty years ago that I saw and gathered a single specimen, and that a weak one, of Lycopodium selago, and also of Osmunda regalis, in the bog below Coleshill Pool; but repeated search has never subsequently been rewarded by another specimen of either plant in that situation."—*Bree*, *Mag. Nat. Hist.*, v. 199, 1832.

OPHIOGLOSSUM.

O. vulgatum, *Linn.* *Common Adder's Tongue.*
Native: In pastures, meadows, and peaty heath lands. Local. May, June.
I. Elmdon, *Cameron;* Maxtoke, *Bree;* meadows near the Rectory, Sheldon, *Jackson, Anal.* vi.; Middleton, near the Hall; heath land near Bannersley Pool; in several meadows and pastures near Knowle; meadows near Blythe Bridge, Solihull.
II. Meadows near Leamington; plantations near Saltisford Common; field near Baly's Locks, *Perry, Fl.* 81; Allesley, *Bree;* in fields near Emscote Cotton Mills, *Baynes*; meadow at Offchurch; near Woodloes and Goodrest, Warwick Old Park; Whitnash Field, *Murcott*; Eastern Green, *Baly, Phyt.* i., 512; near Harborough Magna, *Blox.*; Harbury; Kenilworth, *Y. and B.*; Honiley, *H.B.*; Chadshunt; Gaydon, *Bolton King*; Honington Bridge! *F. Townsend*; pasture by Exhall Hall, Coventry, *Mrs. Browett.*

BOTRYCHIUM.

B. Lunaria, *Sw.* *Moonwort.*
Native: In old pastures and waste heaths. Very rare. May, June.
I. In a close at Sutton Coldfield Park, *Ray, Cat.*, 199; on heathy ground near the upper part of Coleshill Bog, *Murcott, Phyt.* i., 511; near Knowle Railway Station! *W. G. Blatch*; heathy meadows near Middleton.
II. Old pasture on Oversley Hill, *Rufford, Purt.*, ii., 518; Lighthorne (now extinct), *Bolton King.*

LYCOPODIACEÆ.

LYCOPODIUM.

L. clavatum, *Linn.* *Common Club-Moss.*
Native: On heaths. Very rare. July.
I. Coleshill Heath, *Bree. Purt.* ii., 520; Coleshill Bog, *W. Southall, Phyt.* i. 512; Sutton, *Freeman, Phyt.* i. 262; Meriden Heath, *T. Kirk.*; Sutton Park, 1881, *Miss Ethel Stone.*

L. inundatum, *Linn.* *Marsh Club-Moss.*
Native (?): On marshy heaths and near pools. Very rare. July.
I. Coleshill Heath formerly, *Bree;* near the upper end of Coleshill Pool in 1812, Murcott, *Phyt.* i., 512.

L. selago, *Linn.* *Fir Club-Moss.*
Native (?): In bogs. Very rare. April to October. Bog at Coleshill Pool, *Bree. Purt.* ii., 522.*

MARSILEACEÆ.

PILULARIA.

P. globulifera, *Linn.* *Pill-wort.*
Native: On the shores of pools. Very rare. June to August.
I. At Coleshill Pool, where I have found it covering the shore to a great extent! Purt. ii., 519; abundant near Bracebridge Pool in two or three spots, 1876-80; abundant at Coleshill Pool as late as 1881.

* An interesting account of the Lycopods of Warwickshire is given by the Rev. W. T. Bree, in *Phyt.* i., 61, from which it will be seen that none had been seen by him for many years in the localities cited.

EQUISETACEÆ.

EQUISETUM.

E. arvense, *Linn.* *Corn-field Horsetail.*

Native: On damp heaths, heathy roadsides, banks and fields. Common. March, April. Area general.

E. maximum, *Linn.* *Great Water Horsetail.*

Native: Near rivers and in damp places and woods. Rare. May, June.

I. In a marshy copse, Edgbaston, *W. Southall*; Kingsbury Wood, abundant; Bentley Park, near Atherstone, abundant, 1883-84.

II. River Avon; Nicholas Meadow, *Perry Fl.*, 80. In a marshy situation; Arbury Hall! *Kirk Phyt.* ii., 810; Wroxall, *Y. and B.*; Pit near Lawford Road, Rugby, *Blox. R.S.R.*, 1867; abundant, canal siding near Ansty, 1884.

E. sylvaticum, *Linn.* *Wood Horsetail.*

Native: In woods and damp pastures. Rather rare. April, May.

I. About and in New Park! Middleton, near Tamworth, *Ray Cat.*, 100; near Botanic Gardens, *W. Southall, Phyt.* i., 511; near Elmdon, *Cameron, Phyt.* i., 555; Trickley Coppice, Middleton; Kingsbury Wood; Bentley Park, near Atherstone; Frogmore Wood, near Temple Balsall; Earlswood Reservoir.

II. Boggy ground in Grafton Field, *Purt.* i., 501; on the borders of a wood, and in a cornfield near Arbury Hall, *T. Kirk, Phyt.* i., 972; near Norton Lindsay, *H. Bromwich*, Burton Green; Kenilworth, *Y. and B.*

E. palustre, *Linn.* *Marsh Horsetail.*

Native: On damp heaths, in marshes and on other damp places. Local. June to September.

I. Elmdon, *Southall; Phyt.*, i., 512; Sutton Park; near Bannersley Pool; Coleshill Pool; near Solihull; Earlswood.

II. Exhall, *Purt.* ii., 501; boggy field at Norbrooke, *Perry Fl.*, 80; near Budbrook Field, Warwick, *Perry*; meadows at the Woodloes! and Bubbenhall; Stoke, *Baly Phyt.*, i., 512; near Harborough Magna, *Blox. M.S.*; old canal between Newbold and Little Harborough! pond near Cawston, *R.S.R.*, 1877; Beausale! *Y. and B.*

E. limosum, *Linn.* *Smooth Naked-horsetail.*

Native: In pools, marshes, rivers, and canals. Rather local. June to September.

I. Coleshill Pool! mill pool, Bristol Road, *Cameron*; Bannersley Pool! *Murcott Phyt.*, i., 512; Sutton Park! Middleton Pool, near Tamworth; Kingsbury; Bentley Park, near Atherstone; Oldbury Reservoir; Seas Pool, Arbury; Olton Pool, near Solihull; Earlswood.

II. Studley, *Purt.*, ii., 510; windmill field, near Haseley, *Perry Fl.*, 81; St. Nicholas' Meadow, Warwick; Chesterton Mill Pool! near Oldham's Mill, Leamington, *Perry*; several pits in Warwick Old Park, *Murcott Phyt.*, i., 512; Wroxall, *Y. and B.*; Sowe Waste Canal.

b. fluviatile, Linn. Rather rare.

I. Copse, near Elmdon, *Cameron Phyt.* i., 555; Sutton Park; ditches, Kingsbury; near Bentley Park; Oldbury Reservoir; Seas Pool, Arbury; near Solihull; near Shirley; Earlswood Reservoir; pool, near Forshaw Park.

II. Old Park, *Y. and B.*; Sowe Waste Canal; pool, near Till Hill Wood.

This does not seem to be more than a form or state of *E. limosum.*

E. hyemale, *Linn.* *Rough Horsetail.*

Native; In ditches. Very rare. 7, 8.

I. In a moist ditch at Middleton, towards Drayton, *Ray. Gough's Camb.*, 350.

I have examined all the ditches near and about Middleton, but have not been able to find this plant.

CHARACEÆ.

CHARA.

C. flexilis, *Linn.* (Nitella). *Flexible Chara.*

Native: In ponds and pools. Rather rare. June to September.

I. In the third stew, front of the house at Edgbaston, *With., Ed.* 3, 4; abundant in a pool near Hartshill, 1884, Olton Pool; 1881 in company with Mr. James Groves, abundant in a pond near Olton Pool; Earlswood Reservoir; abundant in a small pool on Forshaw Heath.

II. Ditches about Drayton, *Purt.* ii., 435; in a pond near Warwick, *H. B.*; canal, near Ansty.

C. opaca, *Ag. Syt. Alg.* *Opaque Chara.*

Native: In ponds and pools. Rare. May to September.

I. Sutton Park, in Bracebridge Pool and Stews; pool, by Honily Poors Wood; Dickens, near Earlswood; 1883.

C. translucens, *Ag. Syt. Alg.* *Great Translucent Chara.*

Native: In ponds and ditches. Very rare. June.

II. In ponds and ditches, near Rowington, *H. Bromwich.*

I have not been able to find this plant in this district, or in any part of the county. It is many years since it was found, and as these plants were then little understood may be incorrectly named.

C. vulgaris, *Linn.* (Chara). *Common Chara.*

Native: In pools, ponds, ditches, canals, &c. Local. May to September.

Var. *A. vulgaris.* Apparently rare.

I. Bracebridge Pool, Sutton Park; Kingsbury Wood.

II. Pond, near Chadshunt.

Var. *B. longibracteata*, Kütz. More frequent, but local.

I. Drains, Water Orton; Earlswood Reservoir.

II. Corley Heath, *Kirk.*; small pool, near Chadshunt; ditches, near Harbury Railway Station; small pool, near Drayton Bushes; pool, near Stratford-on-Avon; canal, near Bishopton and Wilmecote; pool, near Napton-on-the-Hill; Napton Reservoir; Flecknoe, near Shuckburgh; old lime quarry, near Little Lawford; canal, near Newbold-on-Avon; canal siding, Ansty.

Var. *c. papillata*, Wallr. Very rare.

II. Cattle pond, near Itchington Holt.

A form closely allied to this was abundant in a pit near Little Lawford, almost choking up this pit with its growth; two years later I again visited the same pit, and found that although there was an abundance of the var. *longibracteata*, not a trace remained of the *papillata* form. The plant from Itchington Hall disappeared entirely after the first year, and was also replaced by the variety above cited.

E. crassicaulis, Kütz. Very rare.

II. "Coventry Park, near Coventry, *T. Kirk., Herb. Brit. Mus.*" A Review of British Characeæ, H. and J. Groves, p. 13.

C. contraria, *Kutz.*
Native: In pools and canals. Very rare. July.
II. Canal and pool near canal, Sowe Waste.
C. fragilis, *Desv.* *Brittle Chara.*
Native: In pools and canals. Rare. May to September.
I. Earlswood Reservoir; 1883, Oldbury Reservoir, abundant; near Bolehall, Tamworth, in streams, abundant.
Var. *Hedwigii*, Ag. Rare.
I. Canal, near Knowle, 1870; Spring Pool, Kenwalsey, 1883.
II. Near Harborough Magna, Blox, *M.S.*; canal near Shrewley tunnel on the way for Rowington.
Var. *capillaceæ.* Thuill. Rare.
I. In pools and marshes Sutton Park.

All the species and varieties of this group of plants collected by myself have been submitted to our best authorities on the Characeæ, Messrs. H. and J. Groves, and I am greatly indebted to them for kindly help.

Natural History Notes.

Puccinia Sonchi, Desm.—I am glad to be able to state that *Puccinia Sonchi* has again made its appearance at Hamstead, the only locality as yet recorded for it in Britain, and where it was first found in the autumn of 1884. It is still in the uredo stage, as described by Mr. Grove in the "Midland Naturalist" and "Science Gossip." While it is to be hoped that this fungus will establish itself as a permanent addition to our flora, it should nevertheless be sought for in other localities, as the sonchus upon which it occurs is being gradually exterminated (probably by rabbit fanciers), few plants being now left where they were once abundant.—H. Hawkes.

Guide to the Geology of London.—It is not usual to find a Geological Survey Memoir running through as many editions as a popular novel, but this appears to be the case with Mr. Whitaker's excellent work on the Geology of London, of which the fourth issue has just reached us. Clearly written, carefully revised, and sold at the low price of one shilling, it is a model for all similar works.

Deep Boring at King's Heath, near Birmingham.—The depth of this boring, now being executed by Messrs. Le Grand and Sutcliff, has been increased to 561 feet, with the result that it continues in the Triassic red marls. The gypsum is still present; 350 feet of gypseous beds having now been penetrated.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, November 3rd. Mr. J. E. Bagnall, A.L.S., exhibited for Mr. J. B. Stone, J.P., the following mosses: *Amblystegium irriguum, Hypnum crassinervium, H. falcatum*, &c. Mr.

W. H. Wilkinson exhibited *Schœnus ferrugineus*, one of the bog rushes, a plant new to Great Britain, recently found by Mr. J. Brebner in Scotland. Also from Dr. F. Buchanan White, F.L.S., *Utricularia vulgaris*, *U. intermedia*, *U. minor*; the single-leaved strawberry, *Fragaria vesca* v. *unifolia*; *Polypodium alpestre* v. *flexile*, *Polystichum Lonchitis*, and *Woodsia ilvensis;* also the blue daisy, a variety of *Bellis sylvestris*, from Mount Atlas, and other rare and interesting plants from Scotland. Mr. A. W. Wills, J.P., read Mr. J. D. Siddall's paper on "The American Water Weed, *Anacharis Alsinastrum*, its structure and habit; with some notes on its introduction into Great Britain, and the causes affecting its rapid spread at first, and apparent present diminution." The paper was illustrated by large coloured diagrams of the plant, its flowers and seeds, with sections showing its structural details; besides which Mr. J. E. Bagnall, A.L.S., exhibited specimens of the plant itself, and various sections under the microscopes. The paper was listened to with great interest by the meeting and appreciation expressed of the very able manner in which Mr. Wills had given it.—Biological Section, November 10th. Professor Haycraft exhibited a specimen of the oviduct and ovary of a fowl, and demonstrated by the aid of a diagram the process by which an egg assumes its well-known form. Leaving the ovary as a globular yellow mass (the yolk), it receives a coating of glairy fluid (the white) during its passage through the upper part of the oviduct, and then the calcareous matter (the shell) is precipitated outside that during its progress through the lower part of the oviduct. Mr. A. H. Atkins exhibited a pitcher of Nepenthes, upon which Professor Hillhouse made some interesting observations. Mr. J. Morley exhibited *Asplenium microdon*, a rare fern, which has been found only in Guernsey, near Barnstaple, and near Penzance. Mr. T. Bolton exhibited *Lucernaria auricula*, *Podura aquatica*, and *Asplanchna Brightwellii* (male and female); the latter species is the rotifer in which the male was first discovered. Mr. W. B. Grove exhibited three fungi, new to Great Britain—*Ramularia calcea*, from Hereford; *Cercospora ferruginea*, from Bradnock's Marsh; and *Stachylidium extorre*, from Harborne. On the motion of Mr. Grove, seconded by Mr. R. W. Chase, a vote of regret was passed by the meeting at the untimely death of Dr. Bull, of Hereford, so soon after the completion of his great work, "The Herefordshire Pomona." Mr. W. P. Marshall exhibited and made a few remarks upon the large botanical collection which he made during his last visit to the United States, from Arizona, California, Virginia, Niagara Falls, and the Mammoth Cave, Kentucky. The specimens were much admired.—General Meeting, November 17th. At the meeting of the Microscopical General Section. Mr. R. W. Chase read his paper on "Ornithological Notes from Norfolk," giving details of the plumage and habits of some of the rare birds he had observed, and pointing out the loss of some of the rarer kinds of birds by the drainage and cultivation of the land. In illustration of his paper he exhibited the following birds:—*Œdicnemus crepitans*, Stone Curlew; *Machetes pugnax*, Ruff; *Tringoides hypoleucus*, Common Sandpiper; *Tringa alpina*, Dunlin, all from Norfolk. Mr. T. Bolton exhibited a marine polyzoon, growing on the glass of his aquarium in Newhall Street, *Bowerbankia gracillima* (?). Mr. J. Morley exhibited the following ferns:—*Lastrea Filix-mas, cristata*, originally found near St. Austell, Cornwall; *Lastrea Filix-mas, cristata angustata*, raised from spores; *Lastrea remota*, found in Westmoreland in 1859, by Mr. F. Clowes, of Windermere, the only one found in Great Britain; *Lastrea Filix-mas*, v. *Pinderi*, found near Eller Water, in the Lake district; *Lastrea Filix-mas*, v. *Barnesii*, from the Lake district. He also made some interesting remarks upon the origin of species in relation to plants. Mr. W. B. Grove, B.A., exhibited *Triposporium elegans*, on decaying wood, brought by Mr. W. H. Wilkinson, from Perth. Mr. W. H. Wilkinson exhibited the following lichens:—*Parmelia caperata*, *P. Borreri*, *P. perlata*, and *Cetraria sepincola*, from U.S. America; also *Squamaria crassa*, from Nice, *Pilophoron fibula*, from Scotland, and *Parmelia perforata;* also, the fruit of *Pyrus Japonica*, from Acocks Green.—Sociological Section. At the intermediate meeting held on Thursday, November 5th, at the Mason College, Mr. W. R. Hughes, F.L.S., President, in the chair, Mr. Alfred Browett, the Hon. Secretary, ably read Chapter VIII. of Mr. Herbert Spencer's "Study of Sociology" on "The Educational Bias," upon which an interesting discussion took place. At the ordinary meeting held on Thursday, November 19th, Mr. C. H. Allison in the chair, Mr. W. R. Hughes expounded Chapters IV. and V. of the second volume of Mr. Herbert Spencer's "Principles of Biology," which treat of the "Morphological Composition of Animals." In illustration of the subject, Mr. Hughes exhibited under the microscope, with the assistance of Mr. Thomas Bolton, F.R.M.S., a number of beautiful living specimens, which included *Amœba*, *Difflugia*, and *Foraminifera*, as showing morphological units of the first order; *Spongilla*, *Vorticella*, and *Hydra*, as showing aggregates of the second order; *Lophopus* and *Chætogaster*, as showing aggregates of the third order. Preserved specimens of corals, including *Tubipora* and *Madreporaria*, exhibited aggregates of the third order; and *Chiton*, *Octopus*, and *Amphioxus* exhibited aggregates of the second order. Mr. W. B. Grove, B.A., contributed a number of beautiful illustrations on the black board, showing embryological phases and subsequent developments. An interesting discussion followed the exposition.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D, Zoology and Botany. Chairman, F. T. Mott, F.R.G.S.— Monthly meeting, Wednesday, November 18th. Attendance fourteen (four ladies). The Chairman reported that the annual Fungus Foray was held on the 28th of October, when nine members of the Section, accompanied by Dr. Cooke, of London, visited Swithland Wood and Bradgate Park, collecting 118 species, of which 61 were hitherto unrecorded for the county. The party returned to the Chairman's house, where three edible species were cooked and eaten. These were *Agaricus nudus*, abundant at Hunt's Hill Spinney, near Bradgate, and of good flavour; *Hygrophorus pratensis*, and *H. coccineus*. The two latter species were not considered to be of much value. *Agaricus personatus*, commonly called "Blewitts," has been sold this autumn in some quantities, at the smaller greengrocers' shops in Leicester. There were no exhibits at this meeting. The Chairman read a short paper on "Mr. John Plant's Catalogue of Leicestershire Mollusca," which was prepared in 1850 for Mr. Potter's projected History of the County, but remained still in MS. This list contained 82 species distinctly indigenous, and four either imported or doubtfully named. One half of the species recorded had been added to the county Fauna by the researches of Mr. Plant himself. The Rev. J. Moden called the attention of the Section to a paragraph in "Science Gossip" respecting a proposed deep boring of a shaft 150 feet in diameter, which was followed by an interesting discussion.