TRANSACTIONS

OF THE

PERTHSHIRE SOCIETY OF NATURAL SCIENCE.

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P. 76, line 38, and throughout the paper, for *Dasyseypha* read *Dasyscypha*.

TRANSACTIONS

OF THE

PERTHSHIRE SOCIETY OF NATURAL SCIENCE.

I.—*Methven Moss as a Collecting Ground for Entomology.*

By Wm. Wylie.

(Read 10th December, 1908.)

In looking over the back numbers of the *Transactions* of the Society, I see records of the Butterflies and Moths of Moncreiffe Hill, and the Butterflies of Kinnoull Hill, but no mention seems to have been made of the Butterflies and Moths taken on Methven Moss. Now, this has been a favourite hunting ground of Perth collectors for many years past, and as for myself I have collected over the ground for over twenty years, so that I think I can give a fairly good list of the Macro-Lepidoptera taken there.

It is not for Lepidoptera alone that the Moss is famed, but also for other branches of Entomology. For instance, the Diptera on the Moss are fairly numerous, especially *Haematopota pluvialis* and *Tabanus autumnalis;* in fact, I have many times thought that they are far too numerous, for one has hardly commenced to collect before they show their affection for one in their own particular way. Apart from the two species mentioned above, the entomologist can have a good day's collecting in this group, for some of the species I have taken there are very rare, and in fact I know no other locality for them.

The Odonata that occur on the Moss are fairly numerous. This is not to be wondered at, for there are many bog holes scattered over the Moss, and it is a pretty sight to see these insects gambolling and darting over their breeding ground in the sunshine. I have taken five different species of this group on the Moss. The Hymenoptera are also fairly abundant, as well as the Hemiptera and Coleoptera. I would strongly recommend this ground to any one who collects any of the above groups.

I will now give a list of the Macro-Lepidoptera I have taken on the Moss, but before I go further I may mention that the Diurni (or

Butterflies) are not abundant on the Moss proper, but in the outskirts and vicinity some of the commoner species may be taken.

DIURNI.

Pieris brassicæ, L. Common.
,, rapæ, L. Common.
,, napi., L. Common.
Argynnis selene, Schiff. Rare.
Vanessa urticæ, L. Common in larva stage on stinging nettle.
,, atalanta, L. Fairly common ,, ,,
Satyrus egeria, L. Hedgerow near Tibbermore. A few species.
,, janira, L. Common.
Chortobius davus, F.L. (Large heath). Very rare.
,, pamphilus, L. Common.
Polyommatus phlæas, L. Fairly common.
Lycæna alexis, Hub. } Common amongst rushes.
,, alsus, Fab. }

NOCTURNI.

Smerinthus populi, L. Ova and larvæ common on sallow.
Macroglossa stellatarum, L. Hovering over bedstraw.
Sesia bembeciformis, Hub. Larvæ not uncommon on stems of sallow.
Hepialus lupulina, Hb. Fairly common. Hovering over rank vegetation.
Hepialus velleda, Hb. Rare. Hovering over rank vegetation.
,, humuli, L. Common. Hovering over rank vegetation.
Chelonia plantaginis, L. Rare.
,, caja, L. Common in larva stage.
Arctia tuliginosa L. Common in larva and pupa stages (amongst grass and heath).
Arctia lubricipeda, L. Common in larva stage in autumn.
Orgyia fascelina, L. Common on heath, in larva stage.
,, antiqua, L. Common in all stages, on heath.
Pœcilocampa populi, L. Rare larva on birch.
Bombyx rubi, L. Common in larva stage on heath.
,, quercus, L. Fairly common on heath.
Saturnia carpini, Bork. Larva fairly common on heath.
Platypteryx falcula, W.V. Rare larvæ on birch.
Dicranura furcula, L. Larvæ fairly common on sallows.
,, vinula, L. Larva common on sallows.
Pygæra bucephala, L. Common on birch and sallow in larva stage.
Clostera reclusa, W.V. Common in larva stage on sallow.

Notodonta camelina, L. Common in larva stage on birch.
,, dictaeoides, Esp. Rare. Larva on birch.
,, dromedarius, L. Fairly common in larva stage on birch.
,, zizac, L. Common in ova and larva stages on sallow.

NOCTUAE.

Cymatophora flavicornis, L. Common in larva stage on birch.
Acronycta psi, L. Common in larva stage on birch and sallow.
,, leporina, L. Rare larva on birch.
,, rumicis, L. Larvæ on dock and other low plants.
,, menyanthidis, Esp. Larva on heath, very rare, 2 pupæ.
Leucania conigera, W.V. Flying at dusk. Not common.
,, comma, L. ,, ,,
,, impura, Hub. } Flying at dusk among rushes.
,, pallens, L. }
Hydræcia nictitans, L. On ragwort flower at dusk.
,, micacea, Esp. Flying at dusk.
Xylophasia rurea, Fab. Comes freely to rasp blossom.
,, lithoxylea, W.V. At sugar. Rare.
,, polyodon, L. ,, Common.
Charæas graminis, L. Common on ragwort.
Apamea basilinea W.V. Hovering over grass.
,, gemina, Hub. At sugar.
,, unanimis, Hub. ,,
,, oculea, L. Sugar. Common, some good varieties.
Miana strigilis, L. At sugar. Common.
,, fasciuncula, Haw. ,, ,,
,, literosa, Haw. At sugar and ragwort. Common.
Celæna Haworthii, Curt. Ragwort bloom. Rare.
Caradrina cubicularis, W.V. Sugar and ragwort. Common.
Rusina, tenebrosa; Hub. Sugar. Fairly common.
Agrotis segetum, W.V. } Common at sugar.
,, exclamationis, L. }
,, nigricans, L. }
,, agathina, Dup. } Taken both in larvæ and imago stages
,, porphyrea, W.V. } on heath.
Tryphæna janthina, W.V. } At sugar.
,, fimbria, L. }
,, orbona, Fab. }
Noctua augur, Fab. } At sugar.
,, plectra, L. }
,, c-nigrum, L. }
,, umbrosa, Hub. Ragwort bloom.
,, baja, W.V. At sugar.

Noctua neglecta, Hub. Larvæ on heath.
,, xanthographa, W.V. At sugar.
Tæniocampa { gothica, L. / var. gothicina, } Sallow bloom.
,, instabilis, W.V. }
Orthosia lota, L. Larvæ on catkins of sallow.
Xanthia silago, Hub. Larvæ on sallow.
,, cerago, W.V. Ragwort blossom.
Dianthæcia cucubali, W.V. Larvæ on seedpods of white campion.
Hecatera serene, W.V. Larvæ in some seasons common on sow-thistle.
Polia chi, L. Larvæ on low plants. Common.
Miselia oxyacanthæ, L. Larvæ common on hawthorn.
Agriopis, aprilina, L. A few species on oak near Methven.
Phlogophora meticulosa, L. At sugar.
Hadena glauca, Kleem. Larvæ on sallow and heath.
,, dentina, W.V. At sugar.
,, pisi, L. Larvæ on sallow and birch.
,, thalassina, Naturf. At sugar. Larvæ on low plants.
Anarta myrtilli, L. Flying over heath. Larvæ in heath.
Plusia chrysitis, L. Larvæ on stinging nettle.
,, iota, L. ,, ,,
,, gamma, L. Flying over heath.
,, interrogationis, Hub. Larvæ on heath. Rare.
Conoptera libatrix, L. Larvæ on sallow. Fairly common.
Amphipyra tragopogonis, L. At sugar.
Mania typica, L. At sugar.
Euclidia mi, L. Larvæ on grass.

GEOMETRÆ.

Rumia cratægata, L. Larvæ on hawthorn. Common.
Metrocampa margaritata, L. Larvæ on birch and heath.
Odontopera bidentata, L. Larvæ on birch.
Crocallis elinguaria, L. Larvæ on heath. Fairly common.
Selenia illunaria, Hub. Larvæ on hawthorn and other trees.
Boarmia repandata, L. Larvæ on heath.
Geometra papilionaria, L. Larvæ on birch. Not common.
Cabera pusaria, L. Larvæ on birch.
,, exanthemaria, Scop. Larvæ on heath.
Scodiona belgiaria, Hub. Larvæ on heath. Rare.
Fidonia atomaria, L. Common in all stages on heath.
Hybernia defoliaria, L. Larvæ on birch.
Larentia didymata, L. Flying amongst grass.

Larentia cæsiata, W.V. Larvæ on heath.
,, pectinitaria, Fuess. Flying amongst grass.
Emmelesia albulata, W.V. Larvæ on yellow rattle. Not common.
Eupithecia vulgata, Haw. Larvæ on hawthorn.
,, nanata, Hub. Larvæ on heath. Fairly common.
,, castigata, Haw. Larvæ on low plants.
Hypsipetes impluviata, W.V. Larvæ on arran.
Melanthia rubiginata, W.V. Larvæ amongst arran bushes.
,, ocellata, L. Flying over grass.
Melanippe montanata, W.V. Larvæ on low plants. Common.
Anticlea sinuata, W.V. Larvæ on bedstraw. Rare.
,, badiata, W.V. Larvæ on dog-rose.
Camptogramma bilineata, L. Larvæ on low plants.
Cidaria fulvata, Forst. Larvæ on dog-rose.
,, pyraliata, Bork. Flying over heath.
Eubolia mensuraria, W.V. Flying amongst grass.
,, palumbaria, W.V. Flying over heath.

Besides the Macro-Lepidoptera the Micros are also fairly numerous both in the larva and imago stages on the Moss.

SOME OF THE RARER DIPTERA I HAVE TAKEN ON THE MOSS.

Chrysops cæcutiens, L.
Baccha obscuripennis, Mg.
Atherix Ibis, F.
Psilosoma Lefebvrii, Ztt.
Didea alneti, Fln.
Volucella inanis, L.
Echinomyia grossa, L.
Myopa buccata, L.
Chrysotoxum bicinctum, L.
Tephritis miliaria, Schrk.
Sargus flavipes, Mg.
Do. infuscatus, Mg.
Bombyluis canescens, Mik.
Eristalis intricarius, L.

Names of five Dragon-flies mentioned :—

Aeschna juncea, Linn.
Leucorrhinia dubia, Lind.
Sympetrum scoticum, Don.
Orthetrum cærulescens, Fabr.
Pyrrhosoma nymphula, Kirby.

II.—*Finger Prints and other Modes of Identification.*

By JOHN H. LYELL, M D.

(Read 11th February, 1909.)

The protection of society from crime does not consist merely in the detection and punishment of offences against the law. The perpetrator of the offence has always to be taken into account. Now, if our methods of punishment fulfilled their ideal as perfect deterrents, and our prisons were true reformatories, we should have none to deal with but first offenders. Unfortunately, however, the very opposite is the case. The great majority of those who once see the inside of our jails and penitentiaries do not lose much time in paying a second visit, and hence the recidivist or relapsing criminal invariably forms the bulk of the inmates of such institutions.

Society having much more to fear from the deliberate and skilfully planned felonies of the old experienced hand, than from the misdemeanours of the novice in crime, it is natural that the severity of punishment should increase in proportion to the number of times that the criminal comes before the tribunals of justice. For these reasons the first duty of our authorities consists in having a thoroughly reliable means of detecting the old offender under all the disguises by which he may endeavour to conceal his identity. The wide extension of the practice of keeping careful personal records of all criminals, and their classification and preservation by properly trained Government officials, has thus become of recent years one of the most valuable guarantees of public safety.

BERTILLONAGE.

The earliest method of registering criminals upon scientific principles is known as Bertillonage, so called after the inventor, M. Alphonse Bertillon. In this system the main objects of criminal identification are very well brought out. The means employed by Bertillon was to make a definite physical record of the offender so complete that it would afford an answer to the two very important questions: first, is this individual A the same or a different individual from B, of known reputation? and second, who is this unknown person X, and is his name contained in such and such a register?

The physical record of a criminal, according to the Bertillon system, is taken as follows:—Three operators and three clerks are employed for the work, to ensure accuracy, and the forenoon is selected for the sake of better light. Certain bodily measurements are made, which are carefully recorded on cards which can afterwards be

indexed. The basis of the classification consists of four measurements:—(1) Head length, (2) head breadth, (3) middle finger length, and (4) foot length; their constancy during life nearly always holding good. These measurements are taken on the left side of the subject, because they are less liable to alteration than those on the right side. The stature is also recorded, and this must always be done at the same hour, because it may be as much as half an inch greater after a night's sleep than it is in the evening. The length of the upper and lower portions of the body is next taken. The span of the outstretched arms, the length and breadth of the left ear, and the length of the left arm are then recorded. The colour of the eye is noted; and finally, a photograph of the prisoner is taken in such a special attitude as to bring out his features and profile.

It is unnecessary to describe in detail the very elaborate methods of classifying the records, but the main principles followed may be briefly sketched. A three-fold division of the measurements is adopted. First of all the heights are classed as low, medium, and tall. Each of these divisions is again broken up, using some other measurement such as the length of the head, and the small, medium, and large heads again form the basis of a new sub-division. Then the short, medium, and long footed individuals are sorted out from each class, and so on, until there are finally 81 principal headings, under some one of which the card of each prisoner is in the first instance sorted. Further sub-divisions are then made, the general result being that a total of twelve measures is employed, which being multiplied into one another give more than a million possible combinations.

The mode of consulting this repertoire is almost self-evident. "One sees at once that the determination of the height of an individual allows the search to be limited to a certain number of divisions which the size of the head again restricts to another place of enquiry. The length of the foot, the span of the arms, the colour of the eyes, and so on, by a series of eliminations, allow one to arrive very simply at a smaller and smaller number of records, where the identification can be made at a glance." (Francotte).

The success of the system is considered by many experts to be fully proved, notwithstanding certain apparent objections, one of which being the transitional cases, and another the personal equation of the officials employed in making the measurements. It has been adopted in Paris since 1880, and has obtained a firm hold of the imagination of the people of France. Its inferiority to the employment of finger prints, afterwards to be described, has, however, hindered its general adoption in other countries. A combination of both systems probably affords the ideal method of criminal identifica-

tion, and this has found much more favour than the exclusive use of Bertillonage.

FINGER PRINTS.

Every one is familiar with the peculiar mark left by a greasy finger upon a highly polished surface, such as a window pane, or the blade of a razor. Viewed by reflected light the mark is seen to consist of numerous parallel lines, passing in various directions, and forming a pattern of greater or less distinctness. A careful examination of the tips of the fingers with a magnifying lens at once shows the origin of the impression. The skin is found to be traversed by a series of ridges crossing from one side of the finger to the other, with furrows between, giving the appearance of a ploughed field or the marks left by waves upon a sandy shore. The ridges, being moist with perspiration, readily transfer their outlines to the polished glass or steel, and if the finger-tips are smeared with a little ink the impression can as easily be taken upon a sheet of paper.

No very satisfactory explanation can be given as to why the skin of the hands is characterised by this ridged or furrowed aspect. The irregularities pass right down to the true skin, and the ridges correspond to rows of papillæ, which contain fine loops of nerves and blood-vessels. It is possible, according to some, that the sense of touch may in some way be accentuated by the greater exposure thus given to the tactile organs. The roughened surface of the skin has been thought by others to assist in the grasping of objects, but as the same structure exists in the skin of the feet, the explanation is not satisfactory, unless we are to believe that in the latter case it is a survival of the time when man had a grasping foot like the apes. In this connection it is interesting to note that the same series of furrows and ridges is found in the fingers and toes of the simiadæ. Professor Lydekker has made a study of this subject, and has discovered that, while the patterns found in the lower monkeys and man-like apes resemble those on the human fingers, one type is characteristic of man alone, showing the higher degree of specialisation he has reached even in such a minute particular as this.

Now these ridges and furrows would cease to have any further interest for us were it not for three important characters which they exhibit. It has been mentioned that they form themselves into patterns. The ridges do not run transversely or longitudinally in regular sequence over the finger, but arrange themselves into peculiar loops and arches and curves, some of which are really very beautiful when reproduced in a good finger-print. In the next place it is found that in no two individuals is the arrangement of the ridges exactly the same. It may be in the number of ridges forming the loop, the curvature of the arch, the direction of the whorl, or in some other

character that the difference consists, but the difference is there, and can be accurately estimated and recorded. Not only so, but in the last place the most delicate variations have an extraordinary persistency during the whole life of the individual. The pattern, in short, remains unchanged in its proportions from childhood to old age, and short of actual destruction by a scar, is unaffected by the changes of growth and the wear and tear of daily life.

It is for these three reasons, viz., their forming definite and readily recognisable patterns, the individuality of these patterns, and their persistency, that the finger ridges rise in importance from mere scientific curiosities into data of the greatest practical value.

CHARACTERS OF FINGER PRINTS.

Coming now to the different varieties of finger prints, and how they differ from one another, there are four types which have to be distinguished, viz., arches, loops, whorls, and composites. In doing so there are first of all two fixed points in every impression which must be considered. These are the delta or outer terminus and the point of the core or inner terminus. If we look carefully at a finger print, we can see that at one side there appears to be a little island where one or more ridges divide or branch off in different directions. All this can be made very clear in an outlined finger print. A fine pen is taken, and, starting at the plot or delta, each of the two diverging ridges is inked in with a clean line as far as it can be traced. At once the whole character of the impression is brought out, and what at first appeared a bewildering labyrinth of lines assumes the character of a sharply defined figure. What is known as the "core" now becomes clearly evident. This is seen to be the centre round which the various ridges arrange themselves. It may consist of one or more ridges terminating abruptly, or of two ridges joined at their tops, or of a minute circle or whorl. The determination of the delta and the core is of the greatest importance in orienting the pattern of the finger print, giving fixed points from which the ridges can be counted and other measurements made.

The significance of the different types of patterns can now be understood. In arches the ridges run from one side to another, and make no backward turn, there being in this case generally no delta present. In loops some of the ridges make a backward turn, but without twist, and usually one delta is present. In whorls some of the ridges make a turn through at least one circuit, two deltas being found, one at each side. "In composites are included patterns in which combinations of the arch, loop, and whorl are found in the same print; also impressions which might be deemed to present features requiring their definition as being loops in respect of the

majority of these ridges, and whorls in respect of a few ridges at the centre or side" (Henry, p. 18).

For the sake of greater differentiation a further division of the four types is found necessary. Arches are divided into simple arches and tented arches, the latter being those where the ridges near the middle have an upward thrust, arranging themselves as it were on both sides of a spine or axis, towards which adjoining ridges converge, giving to the pattern the appearance of a tent in outline. Loops, again, are classed as ulnar or radial according to the direction of the ridges, and whorls include those with single and those with double cores. Composites are subdivided into central and lateral pocket loops, twinned loops, and accidentals. Pocket loops are so called from the circumstance that the ridges immediately about the core deviate from the course of the other loops in the pattern, forming a pocket-like figure, which may be in the centre or turned round in a lateral direction on one side or the other. In twinned loops there are two well defined loops, one superincumbent on the other. Accidentals include the relatively small number of patterns too irregular in outline to be grouped in any of the other divisions. In round numbers about 5 per cent. of impressions are arches, 60 per cent. loops, and 35 per cent. whorls and composites, the proportion varying in several digits. Of course the various groups and sub-divisions can be split up indefinitely, and the greater the number of recognisable types the easier becomes the identification of a given finger print. If there happens to be an apparent similarity between two impressions, the minuter details, such as the number of ridges between two points, the termination of individual ridges, bifurcations, interpolated ridges, junctions, islands, and so on, give ample means of comparison. According to Galton there are in every distinct finger print on an average thirty-five such points of reference, in addition to its general peculiarities of outline and core. To see these clearly the impressions require to be photographically enlarged three or four sizes, and, if the prints are made upon rough paper, it is easy to mark and number the points of reference.

MODE OF TAKING FINGER PRINTS.

The mode of taking a finger print is simplicity itself. A half-sheet of foolscap is employed, on which are ruled off a number of spaces where the impressions are made. Above are five spaces for the fingers of the right hand, and in the middle five more for those of the left hand. A slab of polished copper is carefully smeared with a thin film of printers' ink by means of a cylinder, and the prisoner, having inked each finger separately, presses it upon the proper place, rolling his finger from one side to another, so that a

complete print of the whole bulb of the finger is obtained. Two spaces are reserved at the bottom of the slip on which the four fingers of each hand are dabbed simultaneously for the purpose of comparison with the other impressions. The prisoner then signs his name on the back of the sheet, leaving at the same place a further impression of his right forefinger, and after a few notes have been taken of his height, the colour of his eyes and hair, the date of his conviction and so on, the record is complete and ready to be sent to headquarters. There is seldom any difficulty in getting good impressions. If the finger tips of the prisoner are very rough and scarred, he is given some light work for a time until the skin improves, and if he is unable or unwilling to make proper impressions, the warder in charge takes each finger in turn in his own hand and performs the necessary manipulations for him. The record, having reached the Central Police Department, is classified by one officer, and his work is tested by another, before the slip is filed in its proper collection and group. Now suppose, after a year or two, the Central Office receives from some prison governor a slip containing the finger prints of a man on trial for some crime, who is suspected to be under an alias and to be giving false information about himself. A careful examination of the files soon shows whether or not a duplicate of his slip exists, and the true personality of the prisoner is either revealed, or he is found to have no previous record of criminality against him.

Another interesting mode in which finger prints can be used for identification is by employing as a clue the marks left by criminals upon articles which they have handled in committing thefts or other crimes. Owing to the fact that the finger tips are never altogether free from a slight film of perspiration, impressions are readily formed upon such articles as plated goods, window-panes, painted wood, bottles, cash-boxes, candles, etc. These impressions can generally be photographed with greater or less distinctness, and even if not visible, but suspected to be present, they can be shown up by dusting a little "grey powder" (Hydrarg. cum Cret. of the druggists) over the spot. This adheres to the sticky marks, and on brushing off the surplus powder the impression comes into view.

HISTORY OF THE USE OF FINGER PRINTS.

A brief history of how the use of finger prints for the purpose of criminal identification has come about may be of interest. The method was first officially employed in India in the year 1897, at the instigation of Sir William Herschell of the Indian Civil Service, and it was then that Mr. Henry (at that time an official of the Indian Government) was led to formulate the very elaborate method of

classification now in general use, which was the final result of much careful thought and experimenting. It was favourably reported on by a Government committee appointed for the purpose, and was forthwith approved of and adopted generally all over British India. In England Mr. Galton's system had been examined by a special committee appointed by Mr. Asquith in 1894, but was not considered so efficient as Bertillonage for primary classification at least, and the committee accordingly recommended the employment of a dual method, under which primary classification should be according to measurements upon Bertillon's principles, and finger prints should be used for secondary classification. Another committee, however, sitting in 1900, having had before them the results of the working of Mr. Henry's system, sanctioned its adoption by the police of England and Wales in place of Bertillon's anthropometric method, which therefore it has entirely superseded. The Home Secretary's orders now provide for the registration by finger prints of "all persons convicted at courts of quarter sessions and assizes and sentenced to a term of not less than one month's imprisonment, or in any summary court and sentenced to more than one month's imprisonment without the option of a fine, for certain prescribed offences." Somewhat similar instructions exist for Scotland.

Criminal identification by finger prints is now employed all over British India. It has been adopted throughout Australasia and in South Africa. It has been introduced into Ireland, and is being used in a large number of important police departments in the United States. Translations of English works bearing on the subject have been made in Germany, Austria, Hungary, and other continental countries, with a view, no doubt, to its introduction in these countries. Indeed, as Mr. Henry says, there seems to exist good reason for believing that in respect of its effectiveness, simplicity of working, certainty of its results, and inexpensiveness, it must ultimately be employed by all States.

LITERATURE.

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E. R. Henry, C.V.O., C.S.I. "Finger Prints." 1905.
Francotte. "L'Anthropologie Criminelle." 1891.
Lydekker. "Monkey Hand Prints."
"Finger Prints as evidence of Personal Identity."
"Knowledge" Vol. xxiv. 1901.

Whorl.

Composite.
(Pocket Loop)

Arch.

Loop.

Plate I.—Types of Finger Prints.

III.—*Additions and Corrections to the Perthshire List of Mosses.*

By R. H. MELDRUM.

(Read 11th February, 1909.)

Eleven years ago I read before this Society a paper entitled "A Preliminary List of Perthshire Mosses," and to-night I propose to enumerate the additions that fall to be made to that list.

To do this may seem somewhat unnecessary seeing that within the last two years there has been issued a Moss Census Catalogue, in which is detailed, so far as at present known, the distribution of every species throughout the British Isles. In that work, however, the divisions adopted are the Watsonian Vice-Counties, which do not always correspond, singly or in combination, with the civil counties. Thus Perthshire is divided by Watson into three Vice-Counties, viz., V.C. 87 (W. Perth), V.C. 88 (Mid Perth), and V.C. 89 (E. Perth), but W. Perth includes not only part of Perthshire but also the whole county of Clackmannan and a detached part of Stirlingshire. As a result of this combination the mosses of Perthshire, in its ordinary acceptation (which is the area adopted in my paper), cannot be accurately made out from the Census Catalogue. A moss, for instance, recorded in the catalogue for W. Perth, but not for Mid or E. Perth, might be only recorded from Clackmannan, and not occur in Perthshire at all. My list will prevent any dubiety arising in cases of that kind, and in any event the convenience of having a ready-made list of additions, instead of having to hunt through the entire catalogue to find them out, may be considered a sufficient justification for the appearance of this paper.

I am not at present to enumerate additional localities for the species mentioned in my former paper, although I have notes of many additions, but am to confine myself to species and varieties which do not appear in the first list, and I shall indicate any then recorded which may now be deleted. Some few changes in nomenclature will also be noted.

Neglecting varieties, the number of species and sub-species to be added is 46.

These are for the most part records which have been made since 1898, but some are older notices overlooked at that time, or then figuring as varieties but now raised to sub-specific rank. This alteration of status follows from the substitution of the Census Catalogue instead of the Handbook Catalogue as the basis of the list. The change of catalogue further accounts for the disappearance

of certain varieties which are no longer considered worthy of separate naming, and also for the appearance of one or two older varieties which did not find a place in the Handbook Catalogue.

The species to be deleted (again neglecting varieties) number 3. The preliminary list amounted to 411 species, and the addition of the balance of 43 from this contribution brings up the number now on record to the respectable total of 454, the full British list being 619.

Among the additions there are several new to Britain and one new to science. These are all from Ben Lawers or its neighbourhood, and afford a striking illustration of the amazing productiveness of that district. It has been visited so often, and by so many bryologists, distinguished and undistinguished, that one would think it almost impossible to find anything new. Yet within the last 10 years, besides the novelties I have just referred to, a number of other species have been obtained not previously recorded from that area.

A few of the additions here set down have been made by myself and several by local botanists, of whom I may mention Messrs. M'Intosh, Haggart, Menzies, and Dow, but the most noteworthy of the recent discoveries are due to bryologists from over the border, especially Messrs. Dixon, Binstead, Jones, Duncan, Cleminshaw, Cocks, and Monington.

LIST OF ADDITIONS.

The numbers prefixed are from the Preliminary List.

1.* Sphagnum medium, Limpr. Breadalbane.
2. ,, papillosum, Lindb. Add var. confertum.
2.* ,, Austini, Sull. Breadalbane.
3. ,, rigidum, Schp. Add var. squarrosum.
6. ,, subsecundum, Nees. Add var. obesum.
10. ,, acutifolium, Ehrh. Add vars. subnitens, rubellum, gracile, fuscum, and quinquefarium.
14. ,, cuspidatum, Ehrh. Add var. falcatum.
36.* Archidium alternifolium, Schp. Breadalbane.
38.* Ditrichum tenuifolium, Lindb. Callander (Stirton).
39.* ,, zonatum, Limpr. Recorded in first list as var. of D. homomallum, but now raised to rank of sub-species. Var. scabrifolium also occurs.
41. Swartzia montana, Lindb. Add var. compacta.
47. Brachyodus trichodes, Fürnr. The locality for this is Ben Chonzie.
48.* Ceratodon conicus, Lindb. Ben Ledi.
52.* Cynodontium laxirete, Grebe. Recorded in first list as var. of C. polycarpum, but now raised to rank of sub-species.
55. ,, Wahlenbergii, R. & C. Add var. compactum.

56. Dichodontium pellucidum, Schp. Add var. compactum.
62.* Dicranella curvata, Schp. Breadalbane.
64. ,, varia, Schp. Add var. tenuifolia.
75. Campylopus flexuosus, Brid. Add var. zonatus.
88. Dicranum Bonjeani, De Not. Add var. rugifolium.
91. ,, fuscescens, Turn. Add var. falcifolium.
95.* ,, longifolium, Ehrh. Ben Lawers. Accidentally omitted from first list.
105. Grimmia apocarpa, Hedw. Add var. alpicola.
111.* ,, Stirtoni, Schp. Killin (Ewing).
112. ,, subsquarrosa, Wils. Add var. edinensis.
113.* ,, robusta, Ferg. Glen Lyon.
114.* ,, retracta, Stirton. Loch Tay, Loch Katrine.
117. ,, ovata, Schwaeg. Add var. cylindrica.
119.* ,, atrata, Mielich. Ben Lawers, 1838 (Gardiner). Specimen in British Museum.
125.* Rhacomitrium ramulosum, Lindb. Breadalbane.
128.* Glyphomitrium Daviesii, Brid. Killin (M'Kinlay).
129.* Campylosteleum saxicola, B. & S. Callander (Stirton).
137.* Tortula ambigua, Aongstr. Near Cherrybank.
138. ,, muralis, Hedw. Add var. rupestris.
153.* Barbula vinealis, Brid. In Census Catalogue for V.C. 88. Authority unknown to me.
162.* Weisia crispata, C.M. Callerfountain, Dalcrue.
165.* ,, calcarea, C.M. Killin (Haggart).
167. ,, curvirostris, C.M. Add var. insignis.
189. Ulota crispa, Brid. Add var. crispula.
200.* Orthotrichum Schimperi, Hamm. Specimens so named in Edinburgh Botanic Garden Herbarium from Perthshire.
209.* Tetraplodon augustatus, B. & S. Glenshee.
209.** ,, Wormskjoldii, Lindb. Killin.
217.* Funaria calcarea, Wahl. Killin.
222.* Aulacomnium androgynum, Schwaeg. Huntingtower; Longforgan.
231. Philonotis fontana, Brid. Add var. pumila.
232.* ,, seriata, Mitt. Ben Voirlich.
233.* ,, capillaris, Lindb. Killin (Cocks).
242.* Webera proligera, Bryhn. Moncreiffe Hill.
244.* ,, gracilis, De Not. Killin.
249.* Bryum concinnatum, Spruce. Ochils (Lyle).
250.* ,, arcticum, R Br. Ben Lawers; Craig Chailleach.
251.* ,, Lawersianum, Philib. Ben Lawers (Dixon).
253. ,, pallens, Sw. Add var. speciosum.

262. Bryum capillare, L. Add var. elegans.
268. ,, argenteum, L. Add vars. majus and lanatum.
270. Mnium affine, Bland. Add var. elatum.
274.* ,, medium, B. & S. Ben Lawers.
276.* ,, lycopodioides, Schwaeg. Ben Lawers; King's Seat, Killin.
281. ,, punctatum, L. Add var. elatum.
293. Pterogonium gracile, Swartz. Add var. minus.
298. Myurella julacea, B. & S. Add var. scabrifolia.
303. Anomodon attenuatus, Hübn. The record for Ben Lawers should be deleted. It occurs, however, at Elcho.
308.* Pseudoleskea patens, Limpr. Ben Lawers.
310.* Thuidium hystricosum, Mitt. Craig Chailleach (Cocks).
312.* ,, delicatulum, Mitt. Ben Lui.
316.* Pylaisia polyantha, B. & S. Inver.
327. Brachythecium salebrosum, B. & S. Add var. palustre.
329. ,, rivulare, B. & S. Add var. cataractarum.
333.* ,, trachypodium, B. & S. A specimen is in Mitten's Herbarium from Ben Lawers.
336. ,, caespitosum, Dixon. The locality for this should be near Liff, and may be in Forfarshire.
348. Eurhynchium myosuroides, Schp. Add vars. rivulare and brachythecioides.
354. Plagiothecium elegans, Sull. Add var. collinum.
357.* ,, piliferum, B. & S. Ben Lawers.
356. ,, pulchellum, B. & S. Add var. nitidulum.
358. ,, denticulatum, B. & S. Add var. majus.
360.* ,, latebricola, B. & S. Dr. Braithwaite wrote me some years ago that this had been gathered by Holmes in Breadalbane, but he does not record it in his Flora.
360.** Amblystegium Sprucei, B. & S. Ben Lawers (Duncan).
361.* ,, Juratzkannm, Schp. Near Cherrybank; Quarrymill Den.
371. Hypnum aduncum, Hedw. Add vars. gracilescens and intermedium.
373. ,, fluitans, L. Add var. gracile.
374. ,, exannulatum, Gümb. Add vars. brachydictyon, purpurascens, and falcifolium.
375.* ,, vernicosum, Lindb. Near Cherrybank.
390. ,, molluscum, Hedw. Add vars. condensatum and robustum.
392. ,, palustre, Huds. Add var. subsphaericarpon.
392.* ,, dilatatum, Wils. Inver.

394. Hypnum eugyrium, Schp. Add var. Mackayi.
395. ,, ochraceum, Turn. Add var. flaccidum.
398.* ,, turgescens, Schp. Ben Lawers.
409. Hylocomium squarrosum, B. & S. Add var. calvescens.

SPECIES TO BE DELETED.

162. Weisia tortilis. The specimens are W. crispata.
251. Bryum uliginosum. The locality for this may be in Dumbartonshire.
263. ,, barbatum. Mr. Dixon considers this to be B. capillare, var. elegans.

Amblystegium confervoides is erroneously recorded in the Census Catalogue for Mid Perth. The specimens were afterwards found to be A. Sprucei.

NOTE.—Since the reading of this paper, Mr. Nicholson has found on Ben Lawers another addition to the British Flora, viz., Tortula aciphylla.

IV.—*The Pearl Mussel and its Fishery.*

By J. STEWART.

(Read 8th April, 1909).

Pearls are to be found in all mussels, in those inhabiting both salt and fresh water, but when the Pearl Mussel is spoken of strictly then it is *Unio Margaritifer* that is meant. It belongs to the order Unioidæ, which is one of the family of the Lamellibranchia, which belongs to the division of the Mollusca with the large foot, the Pelycypoda, a division almost universal in its distribution. The Unio is a large mussel four or five inches in length, and from two to three inches in breadth, the body being enclosed within the convex valves of shells, which are covered with a horny epidermis and joined together at the upper part by a hard horny C spring-shaped ligament, which tends to throw the valves open, and whose action in this way is controlled by the powerful retractor mussels. In front of the ligament are the beaks or umbones, which are the oldest parts of the shells, and which in some rivers become peculiarly eroded. Between these a tooth is developed in the Unio which strengthens the hinge of the shell. This tooth is a specific character serving to distinguish Unio from the other large fresh-water Lamellibranchs, the Anadontas or Swan Mussels. The whole animal is flattened laterally, is wedge-shaped, and has its anterior end more rounded than the other

Inside the shell is a thin veil of soft animal tissue which covers both valves, reaching out to the edges and joined together at the upper part of the shell. It is fastened to the interior of the shell by a slightly indented furrow, the pallial line. It is an organ of the greatest importance, since from it is built up by secretion the shell, the brilliant shining nacre next to it, the layer of vertical prismatic cells forming the main part of the shell, the epidermis, and, as will be seen, the pearls.

Unio is a somewhat passive animal, which depends for its daily fare on the flowing medium in which it lives. It moves slowly, ploughing up the bottom with its foot, and with the anterior part of the shell buried in the sand or mud, leaving the hinder part free to project into the water. The retractor muscles are slackened, allowing the shell to open and the brachial and anal siphons to spread; the anterior palpi close to the mouth begin flapping. The water then flows in, and most of it is driven through the gills by the cilia lining them, but the solid particles are driven forward by the motion of the palpi and so on into the mouth.

In such a sedentary animal it may be interesting to know how it is possible for the young to spread throughout the rivers. But, like most animals which settle down to a quiet old age—like, for example, the little acorn barnacle on the rocks of the sea shore, and innumerable other instances which need not be cited—it has rather a prodigal youth. At first sight Unio would seem to be viviparous, since on opening one of them one may possibly find, lying between the gills and the mantle, a large number of minute young. But these young have only been hatched there, the animal in fact being incubatory. The young pass the winter in the gill chamber, develop a bivalve shell, and leave through the siphon the following spring. When passed out into the water the valves of the young Unio are gaping wide open, and a long filament floats up from the inside, and this, with the hooks on the inner lining of the valves of the minute mussel, is capable of attachment to any passing fish. When such is made, the glochidium, as the mussel is known at this stage, draws itself up and snaps firmly on with hooks and valves, setting up an irritation, causing a pathological development of a cyst on the skin or gills of the fish to which it has become attached—a cyst which is air and water tight, and in which it completes its development in about six weeks, when it drops off. During the period of encystment the young Unio may be carried many miles from the parent. These glochidia are not preyed on by fishes, since they seem to form a gritty uncomfortable mouthful, a provision, no doubt, equally beneficent for host and parasite. After the parasite stage has been passed, the mussel continues to grow for another three or four years, reaching

the adult breeding-stage in about that time, and during this stage a sufficient death-rate occurs to keep the supply normal, large as the numbers of young are, running to hundreds of thousands, even millions in some species.

Before passing to the economic history of *Unio Margaritifer*, a word might be said as to its distribution in space, which is somewhat striking. It is a northern species, to be found in the northern part of North America, in the northern part of Asia, notably China, and in the whole of the northern Palearctic region, the Alps forming its southern boundary. In Saxony, Bavaria, and in the Scandinavian Peninsula, and in the north and west of the British Isles, notably Scotland and the north of England and Ireland, *Unio Margaritifer* is plentiful. Entering into a little more detail in regard to its distribution in Britain, some of the river basins where it is to be found in abundance may be noted. It is to be found in the Tay Basin. in all the tributaries of sufficent size. In the rivers of the Forth Basin, which are not yet reduced to open sewers, more abundantly in the Teith and Balvaig in the Balquidder region of the Trossachs. In the North and South Esk, in the Dee, Don, and Spey, in the Shin and other northern rivers regular fisheries are carried on for the Pearl Mussel. In the western and southern watershed of Scotland, and in the Irt in Cumberland, and Conway in Wales, and in the rivers in Ireland, the pearl-bearing Unio is to be obtained.

Leaving, then, with this much curtailed account, its purely natural history, something may be said of the economic history of *Unio Margaritifer*. As a food it leaves much to be desired, and beyond a mention of the brook mussel, which of course may equally well be Anadonta, as a somewhat insipid food, which was threatened by Prospero in the play of the "Tempest," that may be passed over. With uncivilised people, of course, in times of hardship, there is proof that Unio was somewhat largely used as a food.

It is quite otherwise, however, when the production of ornament is considered. Pearls and pearl shell are obtained from the mussel under consideration. Commercially the shell has never been a consideration in this country, but in the United States of America it is of considerable importance, indeed so much so that within recent years a Government grant has been given, in order that inquiry may be made into the whole question of supply and protection of the mollusc. But it is the question of Unio as a pearl-producer which must occupy the remainder of this short paper. And even with that limitation, I can only touch on one or two of the more important points. As has already been pointed out, the mantle lobe which surrounds the entire animal inside the shell produces the shining nacreous inner lining of the shell naturally. Pathologically, it pro-

duces pearls. Around minute parasites which lodge there, there grow from, or are secreted by, the mantle, cysts which enclose the parasites, and these are the beautiful milky gems we call pearls. Their production is not one of the least interesting of the mysteries which scientific workers have solved within recent years. The earlier scientists, as was their wont, argued how the pearl must be produced without, as usual, troubling to investigate further. Their lack of apparatus, of course, had, no doubt, much to do with the frame of mind which led them to argue from general principles into which they wrought in divers ways their somewhat refractory natural facts. And so we find that pearls, in olden times, were produced from many curious things, or said to be. The drops of dew which the mussel swallowed when it came to the surface, a most unusual proceeding now, were extraordinarily productive, and even the lightning from heaven smote the mussel, and only produced a pearl. At a somewhat later period, a grain of sand was accepted as the nucleus round which the pearl was formed, and that fairly generally. Poets wrote beautiful verses on this, on what indeed is the rare exception in the production of pearls. On this theory too artificial margarosis was attempted, and that by the great naturalist Linneus himself. His methods have only come to light within the past few years through the researches of Professor Herdman, and were essentially very simple. Minute limestone particles were to be introduced into the shells by thin flexible silver wires, and these nuclei were to be kept near the ends so as not to incommode the animal, and sufficiently far in so that they should not become attached to the shell. But how the completed pearl could be formed with no mark of the wire seems quite unexplained.

In 1558, Rodeletius made the happy guess that pearls were produced in a manner similar to the Cestode larva in measly pork. It could only be guessed, since he had no optical apparatus to verify his suspicion, and we must pass on to the nineteenth century till we find a true scientific proof of pearls being encysted larvæ. Gesner, in 1871, showed that Distomes, as he called them, could be got in Anadonta cygnea. In 1902, Dr. Lyster Jameson showed fully the whole life history of the Trematode, which, in its larval form, becomes encysted in Mytilus to form pearls. The adult life of the Trematode is passed in the eider duck, which lives largely on the mussel. In 1903, Dubois showed that the pearls in Unio were formed around Distomum larvæ. Where the other stages are passed is as yet uncertain, but sufficient has been done to show fully that the pearl is a cyst secreted around a larval form of a flat worm.

Turning now from the production of pearls to a history of the fishery in these islands, one meets with the fact that they were sought

for from the earliest times of which we have written records. Tacitus, in the Agricola, speaks of them, *sed subfusca et liventia.* Pliny, in his Natural History, speaks of them in the same way, *parvi et decolores.* Bede, the ecclesiastical writer, speaks of them as being of different colours, *rubicundi et purpurei et hyacinthini et prasini sed maxima candida.* Coming to the Middle Ages, one finds quite an amusing description of the fishery for pearls by the topographical writer, Boece. Later, in the end of the sixteenth century, an attempt was made to place the fishery on a commercial basis. James VI., "the wisest fool in Christendom," was presented with a large pearl which had been obtained from the Ythan in Aberdeenshire, and his attention was drawn no doubt to the possibility of much wealth escaping him, and he had a Commission appointed with powers to appoint buyers in all the districts, and penalties for all who bought pearls without permission. The following letter shows the methods adopted :—

SEARCH FOR PEARLS IN SCOTLAND IN 1622.

EARL OF MELROS TO JAMES VI.

MOST SACRED SOVERANE.

Understanding by my Lord Chancelar that the Earl of Kellie, by his letter, had signified to him that it was your royal pleasure that I sould advertise what order was prescrived for the timely and convenient search of pearles in this Kingdom, with the effects thereof. For obedience of your Majestie's commandements, by the letter first sent to me for that purpose, I conferred with the Lord Chancellor and Advocate, and by their advice and concurrence, directed commissions to Sir Robt. Gordon, and in his absence, to his brother, Sir Alexander, for Sutherland; to the lord of Kintall, for the waters in Ross; and to W. Patrick Maitland of Auchcrief, for the waters of Ythan; and others within the Schiredome of Aberdeen, with power to Maister Patrick Maitland to receive all the pearles that should be found to your majestie's use, geuing due satisfaction to the takers thereof. I have not hard the effects of Sir Alexander Gordon's diligence, but have of new remembered him of your majestie's direction, and his owne dutie, I have spoken to the lord Kintail in his towne, who says he has not hard of any pearle taken since his commission, in the waters of Ross. Mr. Patrick Maitland perseived some men of Aberdeen before the Counsell for their unlawfull buying of pearles since the proclamation, who, compeiring, some confessed a small quantity of pearle of no value, ; the rest being sworn and examined denied. Order was taken with the contravenars, and they acted under great panes to absteane from that trade, and the proclamation commanded to be of new published, to restrain the abuse of unlawful buying. I am informed that there are sundrie other rivers in this kingdom where pearles are to be found, as the water of Forth, the water of Cart before Paisley, and some waters in Galloway, but I heard not of any pearles of worth being found therein but verie rarielie.

If it please your majestie to make choice of any dwelling in those cuntries to take charge of the rivers, commissions shall be given as they shall be directed. So praying God long and graciouslie to preserve your majestie, the pearle of kings, I rest your sacred majestie's most humble and faithful subject and humble servant.

MELROS.

Patents, too, were granted, one of which was to a Mr. Buchan of Auchmacoy, on the banks of the Ythan, and it seems to have been irksome to others, for in searching for traces of this Patent, it appears that it was complained against, and after a delay of three years, was remitted to the Privy Council of Scotland to deal with it. After a further six years, his agent was heard concerning it, and in 1641, judgment was delivered in the following terms:—"That it shall be lawful to all persons to fish pearls in the waters of this kingdom, and to sell the same to whatsoever person they please, and none to be prohibited by said; and the time of fishing to be June, July, and August, and all the haulding courtes and punishing the contraveners of the Patent discharged, and an Act made hereupon."

In the eighteenth century there seems to have been one or two years of great prosperity in the fishing, and then it again drops out of public notice till the nineteenth. In 1864-65 there was a period when, from public notices, one was led to suppose that some kind of organised attempt was made to put the fishing on a commercial footing. A dealer in jewels in Edinburgh toured through Scotland and purchased many pearls, and entered into agreement with people living on the banks of the rivers for the succeeding season, and obtained advancement of sums of money from firms in Edinburgh. Finding himself unable to carry out the terms of his contract, he hastily left the country the succeeding year, and the activity in the fishing came to an end. Since that time a yearly turnover of about three to four thousand pounds takes place in the fishing, there being a few men on the banks of the most notable rivers earning their livelihood at the industry. But there has been no attempt at improving it in any way, nor does any seem likely to take place.

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V.—*The Dyke Rocks of the Schiehallion District.*

By GEORGE F. BATES, B.A., B.Sc.

(Read April 8th, 1909).

If we examine a geological map of almost any part of the Highland area of Scotland, we cannot fail to be struck with the large number of lines thereon, indicating, as most of us know, the existence of dykes and sills of igneous rock. If, better still, we take an actual trip to the area included in the map, we shall find here, there, and everywhere, small road-side quarries, often of a more or less trench-like shape; and on examining the rock worked out of these quarries, we shall at once notice that it is more or less obviously igneous, and often totally different from the surrounding rocks. More careful examination of the country will show the existence of numerous other spots in which these igneous rocks occur, but in which, for some reason or other, they are not quarried. As a matter of fact, in the Scottish Highlands there must be thousands of these dykes and sills, and to work them out in detail would tax to the utmost the resources of a long and busy life.

In this paper I wish to direct your attention for a short time to what, for want of a better title, I may term the Schiehallion district. This term must, however, be understood in a limited sense, for the area to which I shall refer lies wholly to the North and North-west of the mountain, and is included entirely in that part of the valley of the River Tummel and its tributaries which lies between Lochs Rannoch and Tummel. It is a district of remarkable picturesqueness. Most people have seen the "Queen's View" from the rock which overhangs the River Tummel at its outlet from the eastern end of the loch—the broad expanse of river and loch, woodland and meadow, backed by the lordly Schiehallion, form a picture upon which the gaze of the beholder rests with wondrous satisfaction. But not everybody has penetrated into the heart of the region thus viewed, and scrambled to the top of Schiehallion, or Ben Chuallaich, or of the smaller heights, which form the sky-line to the south. And yet this district is well worth examination in detail, from either an artistic or a scientific point of view. It abounds in picturesque "bits"—romantic cascades are hidden away in half-concealed glens, and delightful glimpses of lake and woodland are met at every turn. The botanist will find interesting plants by the dozen, even if he meets with no rarities to gladden his heart. But perhaps the geologist is the one who will derive the highest enjoyment from his investigations, especially if he

has the faculty of connecting geological facts with scenery. Not only will he meet with an almost endless variety of metamorphic rocks, but he will see everywhere obvious traces of the action of ice, and, at the head of Loch Tummel, see a splendid example of the gradual filling up of a loch by detritus brought into it by a river.

The geology of this region is extremely complex. Excluding the rocks of igneous origin, the commonest rock is quartzite, this being most prevalent in the southern half of the area. Schiehallion itself is largely built of quartzite, and exhibits in a remarkable degree the characteristic weathering of this rock. "Schiehallion, in Perthshire, is a noble instance of a cone not yet freed from its parent ridge. Seen from the south-east, it appears as a long rocky ridge, mounting slowly from the east and descending abruptly at its western end. But from the north-west, the ridge appears as a perfect cone, raising its gleaming peak of snowy quartzite to a height of 3547 feet, and throwing its rocky declivities far into the moors on either side."* Quartzite also composes the eastern half (including the summit) of Ben Chuallaich, the smaller brother of Schiehallion, which rises steeply on the opposite side of the strath, north and east from Kinloch Rannoch. To the west and north of the quartzite we have various forms of mica-schist, while "black schists" prevail in the neighbourhood of Loch Tummel, and outcrops of limestone, of greater or less extent, are frequently met with. All these rocks belong to the type which Geikie has named "Dalradian"; they are all (except the limestone) probably of clastic origin, and the complete absence of definite fossils—due to the metamorphism which they have undergone—makes the exact determination of their geological age an impossibility in the present state of our knowledge.

If now we take a general view of the rocks of those Highland regions which are generally regarded as being of igneous origin, it is found that they fall more or less readily into two types. In one type it is found that the constituent minerals are more or less drawn out into distinct layers, *i.e.*, these rocks present that appearance of foliation which is so characteristic of the metamorphic rocks by which they are surrounded; and it is a legitimate inference that their intrusion took place before the metamorphism occurred. As examples of such rocks, we may quote the epidiorite of Ben-y-Vrackie and Loch Kynardochy, and the foliated granites of Ben Vuroch and Glen Tilt. (Of course it is not beyond the bounds of possibility that some of the rocks of the Highland complex may be igneous rocks which have been metamorphosed to such an extent that their igneous origin can no longer be recognised).

* Geikie: Scenery of Scotland, ch. ix.

In the second type of rock there is no foliation, the constituent minerals being devoid of any definite arrangement, just as in the igneous rocks of non-metamorphic regions. Here we are justified in assuming that the intrusion of the igneous rock took place after the metamorphism of the surrounding rocks. Examples of this type are met with in the granites, etc., of Glen Banvie, Ben Alder, and Ben Chonzie.

These two types of igneous rocks may be spoken of as "older" and "younger" respectively.

If we now turn to Sheet 56 of the Geological Survey Maps we find in its eastern portion (in which Schiehallion lies) an immense number of dykes indicated, and it will be observed that these trend in a general direction from north-east to south-west. Outside the area covered by the map there are three of the younger intrusive igneous masses, namely Glen Banvie granite on the north-east, Ben Alder granite on the north-west, and Ben Chonzie granite on the south-east. With comparatively few exceptions the igneous rocks of our area are also of the "younger" type, and it seems impossible to resist the conclusion that our dykes are in some way connected with the surrounding intrusive masses.

It may be remarked here that in the Highland area we can draw no distinction between dykes and sills. In practically all cases the smaller intrusive masses of igneous rock have risen along the foliation planes of the metamorphic rocks: when these are vertical or highly inclined, we have a dyke, when horizontial or slightly inclined, a sill, but all intermediate stages may occur. The general north-east and south-west trend of the dykes is of course due to the fact that this is also the direction of the foliation planes in the greater part of the Highland rocks.

Tummel Bridge may be taken as a convenient starting point for our present purpose Following the Aberfeldy road for about a mile, we begin to ascend over the shoulder of Craig Kynachan, past the hamlet of Foss, and finally attain a height of between 1200 and 1300 feet. On our right there is now Loch Kynardochy, an uninteresting sheet of water, partly surrounded by peat. A little further on, having passed a limestone quarry (well worth a call in passing), we turn abruptly to the right, passing on the other side of the loch already noticed. On our left is an exposure of epidiorite, almost entirely concealed with heather, and badly weathered where exposed in the bed of a small burn which crosses the road. Soon we come to the head of a steep descent, leading down into Strath Fionan, which lies between Schiehallion on the south and Craig Kynachan on the north. We are now entering the area in which the dykes are well developed; and in the course of the next three miles the road crosses

no less than eight dykes. Now everyone who has done even a little field geology knows the difference finding the outcrop of a rock as marked on a map, and the actual outcrop in nature. It is all very well if the rock is quarried, but if it isn't, and if, in addition, the whole country side is overgrown with heather and coarse grass, the difficulty of finding may be very great. No one need be surprised then to learn that I spent a considerable portion of several days in examining, most minutely, the hillside along these three miles of road. Two of the dykes are quarried for road metal—they are easy enough to find: in one case the exposure, though good enough when found, is almost concealed by a bridge; in two cases the outcrop was found after long and careful search, but the rock was so badly weathered that nothing short of blasting would serve to procure fresh specimens; two offered no special difficulty, and one I could not find.

Perhaps it will simplify matters if the dykes are numbered in order of occurrence from east to west.

No. 1. This is a fairly broad dyke, composed of a brownish red compact rock, and is inclined at a very high angle. It is quarried for road metal, so that fairly fresh specimens are easily obtained. The rock is rather finely grained, crystals large enough to be seen with the naked eye are comparatively rare.

When examined microscopically, the rock is found to be composed mainly of felspar crystals, reddish in colour, and presenting good outlines, but highly turbid owing to the presence of decomposition products. Quartz is present in the interspaces, and we find in addition a considerable amount of green chloritic matter, which has probably been formed by the alteration of ferro-magnesian minerals, chiefly biotite, but possibly also of hornblende. Among accessory minerals, zircon, apatite, and iron ores may be noted.

It is extremely difficult to fit a rock of this kind into any scheme of classification. The presence of felspars and quartz shows its affinity with acid rocks, while the ferro-magnesian minerals (or their alteration products) indicate a connection with the basic division. It would seem to be intermediate between quartz-porphyry on the one hand and dioritic mica trap on the other, and is apparently one of the rocks to which the name "Strowan porphyry" is given in the Memoir of the Geological Survey which deals with this district.

No. 2. This dyke lies to the east of the farm-house of Braes of Foss, and for some reason or other is not marked on the geological map. It is the one whose exposure, as mentioned above, is concealed by a bridge, though its course is indicated by irregularities on the surface of the ground for some distance towards the west. It is totally different in appearance from the rock previously described,

although occurring at quite a short distance from it. Examined with the naked eye, the rock is seen to be of a dark green colour, spotted with pinkish felspar, which is locally very abundant, forming almost what might be described as "nests" of this mineral.

The structure of the rock, as revealed by the microscope, is full of interest. We note in the first instance an abundance of augite, consisting in some cases of well-marked crystals and in others of rounded grains. By transmitted light it appears almost colourless, but the greenish tinge is revealed by reflected light. Less abundant is a brownish green hornblende, sometimes idiomorphic, and sometimes showing a parallel intergrowth of secondary hornblende (uralite). The ground mass of the rock consists of felspars; both orthoclase and plagioclase are present, but the orthoclase predominates. As usual, decomposition products are abundant; in addition to the usual green chloritic matter, a yellow mineral, probably epidote, is present. Accessory minerals are fairly numerous; calcite, apatite, sphene and ilmenite can all be recognised more or less readily; and there appears to be a small amount of residual quartz. (Plate 2).

This rock may be regarded as a lamprophyric or mica-trap, in which biotite is replaced by another ferro-magnesian mineral (hornblende or augite). To such a type of rock the name vogesite is applied, and owing to the predominance of augite over hornblende, we may speak of this particular example as an augite-vogesite. Altogether it is one of the most interesting rocks I have examined.

No. 3. This dyke was extremely difficult to find, and it was only after going over the ground several times that I at last discovered it. It is completely hidden except in the actual road-way, and it was only by breaking up the surface that I could secure specimens—needless to say, they were not perfectly fresh, and so I have not had sections made. The rock somewhat resembles that of the previous dyke in appearance, but is much finer grained. It is marked as a lamprophyre on the map.

No. 4. Like No. 3, this dyke was very hard to find. There is no sign of it on the road-side, but by ascending the hill a little to the south of the road, it is seen forming a distinct ridge to the right of a small depression in the surface of the ground. This ridge is almost entirely overgrown with heather, etc., and only a small portion of the dyke is actually exposed. As might be expected, the exposed rock is badly weathered, and it was only after prolonged hammering that I succeeded in securing specimens of even moderate freshness. Sections for the microscope were out of the question. To the naked eye or lens the rock presents a somewhat fine-grained texture, with quartz "blebs" which frequently project on the weathered surface.

It is of a dark greyish-green colour, and may probably be termed a quartz-diorite-porphyrite.

No. 5. Of all the unquarried dykes in Strath Fionan this is most easily found, being readily recognised on both sides of the road, and for some distance in a north-easterly direction; while little difficulty is experienced in hammering out tolerably fresh specimens. The rock is fairly hard and compact and of a reddish-grey colour; porphyritic felspars and "blebs" of quartz can be readily recognised with the naked eye. The microscope shows that it is largely composed of plagioclase felspars, with quartz filling up the interspaces. The usual green decomposition products are present, some of them showing by their contours that they represent biotite. Augite is also present, but not in very large amount; while the acessory minerals are represented by the ubiquitous iron ores and apatite. The systematic position of this rock is not very difficult to determine—it shows all the essential features of a porphyrite (granite porphyry), but has obvious affinities with the lamprophyres. (Plate 3).

No. 6. This dyke I was quite unable to find, even after prolonged search. A short distance, however, west of its position as shown on the map, and close to a wall which here comes down to the road, I found a magnificent exposure of ice-polished quartzite. I had previously been shown a hand specimen taken from a point high up on the shoulder of Schiehallion, but this rock down in the valley was fully as well polished as that from the higher position. So smooth and round was the exposed surface that it offered no point of attack for the hammer, and I was reluctantly compelled to come away without a specimen. It has already been mentioned that the whole neighbourhood has been powerfully glaciated, but perhaps there is no stronger evidence for the fact than the existence of these polished surfaces of quartzite. It may also be of interest to note that I found a boulder of diorite—probably from the Moor of Rannoch, considerably above the 2000 feet contour line on Ben Chuallaich.

No. 7. This is another well-marked dyke, and is quarried for road-metal to the right of the road. It has a more or less well-marked outcrop several miles in length. In hand specimens it resembles very closely the rock of the first dyke mentioned, except that it contains numerous dark-green masses of earthy-looking chloritic material, which are very conspicuous, and indicate the presence, originally, of abundant hornblende or other ferro-magnesian mineral. I have had no opportunity of examining this rock microscopically, but the remarks made as to classification and nomenclature of the rock from No. 1 dyke would apparently apply here.

No. 8. This, the last of the dykes of Strath Fionan, was found only after considerable search. I can, however, say nothing definite about it, as it was quite impossible to get fresh specimens by using any agent less powerful than dynamite!

Still following the same road, we gradually ascend out of Strath Fionan, after which the road falls rapidly to the valley of the Tummel. Loch Rannoch comes into view, and bearing to the left, its southern shore is soon reached. On our left rise the lower slopes of Meall Dearg; crossed in north-east and south-west direction by a number of dykes. But the ground is so completely overgrown that I was able to find one only, though myself and a friend traversed the ground several times over.

The rock is, however, of an extremely interesting type. It is of a dark grey colour, and without any well-marked porphyritic constituents, as far as can been seen with the naked eye. The ground mass consists apparently of felspars, but as is so often the case, these are so completely altered that their identification is a matter of some difficulty. The ferro-magnesian constituents, on the other hand, are unusually fresh, and consist of biotite and hornblende, both abundant, and augite, much less so. It is rather difficult to say whether biotite or hornblende is more abundant, but, on the whole, I am inclined to think that biotite holds the first place. Both this mineral and the hornblende are exceedingly well marked, and show their characteristic outlines and optical properties in a manner that I have rarely seen surpassed. (Plates 4 and 5).

The parallel intergrowth of secondary hornblende with the primary form of the mineral, already mentioned in discussing a previous rock, is also shown here, while the larger crystals of hornblende show numerous enclosures. In some parts of the section ilmenite, with its usual accompaniment of leucoxene, is rather abundant; and apatite and calcite are also present as accessory minerals.

This rock is undoubtedly a lamprophyre, but owing to the altered condition of the felspars it is difficult to say whether we should describe it as dioritic or syenitic. Perhaps the simplest way would be to call the rock a hornblendic mica-trap, from the abundance of hornblende it contains.

While making no pretence to exhaustive treatment of the dykes of our area, I cannot close without reference to some interesting igneous rocks which occur on the northern shore of Loch Rannoch, just within the area included in Sheet 55 of the Geological Maps. The most conspicuous of these is a sill which is well exposed on the north-western side of Ben Chuallaich, and crosses the road a short distance west of the village of Kinloch Rannoch. It is a pale grey

rock, showing porphyritic felspar crystals, often of considerable size. Microscopic examination shows that these crystals are full of decomposition products, but usually they retain sufficient of their optical properties to be identified as orthoclase. A small quantity of quartz is also present, but in my section, at any rate, the ferromagnesian constituents are so badly altered as to be almost unrecognisable. Pyrites is a conspicuous accessory. The rock is a diorite porphryrite.

Somewhat nearer the village, on the shore of the loch, I came across a large number of blocks of a peculiar rock which I was informed had been taken out in digging for the foundations of the new hotel, which apparently is built partly, at any rate, upon a dyke. The general mass of this rock is almost black, and in the blocks which I saw, badly decomposed, but a feature of considerable interest is the existence of numerous "nests" of biotite, in the form of bright brown scales. This is a comparatively rare occurrence in the rocks of this district. "Very seldom does the biotite occur large brownish, glancing scales, as in the well-known lamprohyres of the Lake District, the Hartz and Brest."*

With this brief reference I must conclude. There is still plenty of work to be done on these dykes, and I hope that in the not distant future I may have an opportunity of continuing what I have begun.

VI.—*The Cuckoo.*

By Atholl MacGregor.

(Read at Excursion to Glentarken, 12th June, 1909).

There has been so much writing about the cuckoo that it requires some courage to add to it. The following remarks are the result of an exceptional opportunity the writer had last July of observing the habits of a full-fledged young bird. It took up its residence in the grounds on July 21st, and finally disappeared on the 6th August.

The grounds, extending to about 6 acres, are almost surrounded by the town, and have scattered houses on all sides. They contain a number of large beech trees, limes, elm, cherry, hazel, elder, apple, pear, plum, sycamore, broom, etc., and being very quiet the bird was probably thereby induced to remain.

Its favourite perch was the wire on which the lawn-tennis net is hung, and here it would sit motionless for long periods, occasionally

* Geological Survey Memoir on Sheet 55.

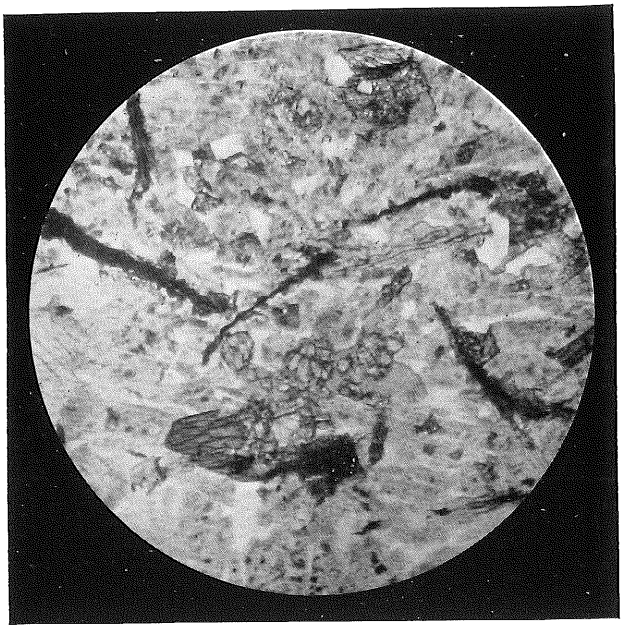


Plate 2.—Vogesite, Dyke near Braes of Foss (x 30).

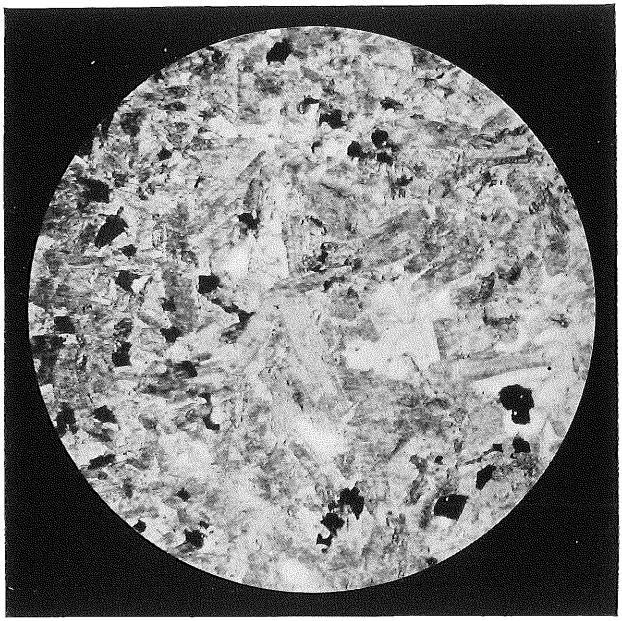


Plate 3.—Porphyrite, Strath Fionan (x 35).

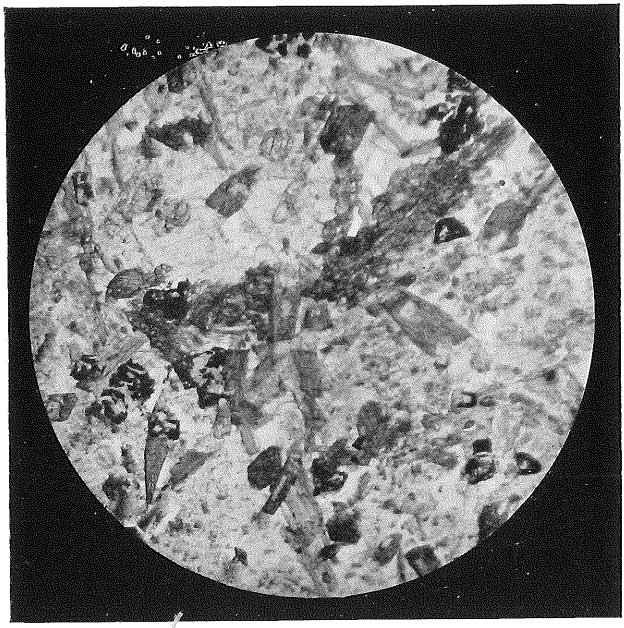


Plate 4.—Hornblendic Mica Trap—Dyke near Loch Rannoch (x 30).

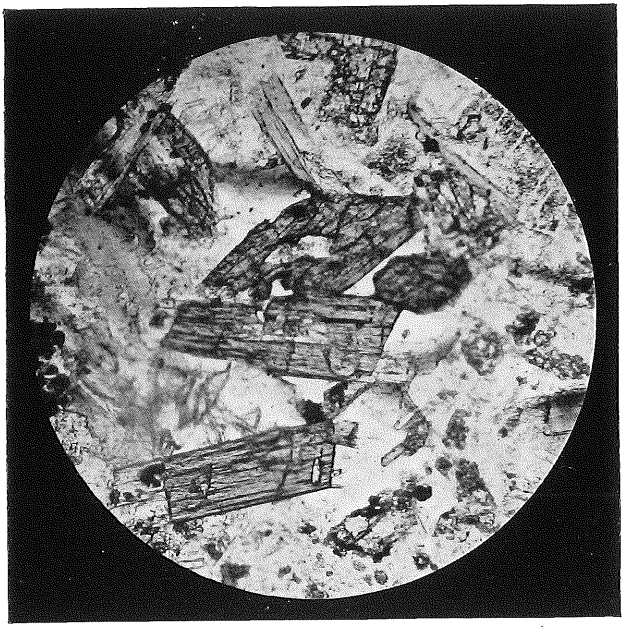


Plate 5.—Hornblendic Mica Trap—Dyke near Loch Rannoch (x 99).

flying down to the ground, apparently to capture a caterpillar, beetle, or daddy-long-legs. Its movements were clumsy in the extreme, and even on the closely-mown turf it did not seem able to move a couple of yards without using its wings. Clearly, the short legs and slender zygodactyle feet incapacitate it from hopping on the ground, or from branch to branch. When on the wing the flight was strong, rapid, and hawk-like. It was evidently taken for a hawk by the small birds, of which there are seldom less than a dozen on the lawn—blackbirds, thrushes, starlings, wagtails, sparrows, etc. These disappeared altogether during the cuckoo's visit, only returning gradually after its departure, and for some days keeping close to the surrounding bushes.

The writer has lately had the opportunity of observing more than a dozen cuckoos, in open woodland and on the moors, and found that their movements corresponded closely with those of the young bird described above. They showed the same want of alertness and apparent inability to move except by their wings. Among trees they alighted generally on the ash trees, which were bare, and sat close to the branch, rather along it, like a nightjar. On the moor they generally alighted on a stone, from which they occasionally flew down into the heather, alighting again on another stone, but never hopping or moving otherwise than by their wings, even when there was short grass.

When, in contradistinction to this habit, one thinks of the incessant activity of the wagtail, pipit, and other small insectivorous birds, of the class selected by the cuckoo as foster parents for her brood, hopping from branch to branch or running along the ground, taking insects every second, and when one considers that even so it takes a pair of such birds all their time to feed one young cuckoo, the conclusion forces itself on one's mind that for a pair of cuckoos to feed half a dozen young ones, in addition to providing themselves with food, would be a sheer impossibility. Thus the abnormal parasitic habit becomes a necessity, forced on the bird by its structure and environment.

In addition to the consideration that large caterpillars, beetles, etc., which alone the cuckoo can take in any quantity, would be unsuitable food for nestlings, it seems probable that, just at the time the young are being hatched, the supply of large caterpillars is at a low point. Many of the larvæ hibernating have by that time spun up, and are not available, while many newly-hatched caterpillars are only just emerging. The principal large caterpillars represented in our Museum are that of the Tiger Moth *(Hypercompa caia)*, that of the Fox Moth *(Bombyx rubi)*, and that of the Emperor Moth *(Saturnia pavonia)*. The first of these is noted as being in the larva

stage from August to May, the second from September to April, and the third in July and August. Thus none of them occur in June, when the pressure would be greatest if the cuckoo reared its own young.

This part of the subject suggests an interesting field of inquiry to the entomologist, who must here come to the assistance of the ornithologist. Moving south to climates where insect life is more forward, the old birds do not further trench on the supply which must sustain the young when their foster parents leave them tot heir own resources.

It will be asked why in that case does the cuckoo visit these shores? A book by Otto Herman, brought out under the auspices of the Ornithological Department of the Hungarian Ministry of Agriculture, called "Birds Useful and Birds Harmful," has lately been translated into English. It classifies the cuckoo as "most useful as regards food, which consists for the most part of very mischievous insects and caterpillars. It is the more so as the bird is insatiable." In Newton's Dictionary it is described as the "beneficent destroyer of hairy caterpillars," and in Lloyd's Natural History Bowdler Sharp refers to it as "devouring the larvæ of the tiger moth, popularly known as the woolly bear, the hairs of which are found in large numbers in its stomach." Further, and most important, Lydekker, in his Royal Natural History states that "it is believed to be the only bird eating hairy caterpillars." The daddy-long-legs *(Tipula oleracea)* is also preyed on by it, an insect easy to catch, the larvæ of which, known as *leather jackets*, feed on the roots of grass and corn. To deal with such creatures, a bird of considerable size is evidently required, with specially adapted power of digestion. It would probably have been a serious matter if they had been allowed to multiply indefinitely, without any enemies, and if so, by this time these pests might have assumed formidable dimensions.

It seems not unreasonable to conclude that we have here an instance of a supreme effort to maintain the balance of nature, under exceptionally adverse conditions, by providing for the breeding and rearing, in an abnormal manner, of a suitable species. Thus may we not here have the explanation of the extraordinary breeding habit, which, as Lydekker truly says, in his "Sportsman's British Bird-Book," "reads like a romance, and is one of the greatest marvels of bird life."

Reference has been made to the hawk-like appearance of the cuckoo, which is not only in general appearance and flight, but in coloration of the eyes, in the barred under-parts, and long thigh feathers. It has been suggested that the object of this is to enable the male to create a diversion by causing itself to be mobbed, and drawing off

the birds of the nest while the hen deposits the egg. This may sometimes occur, but it seems a simpler and more likely solution to hold that the male, by his sudden appearance, puts the nest owners to flight, and that the opportunity is then seized of examining the nest or depositing the egg without attracting suspicion that might lead to desertion.

There is a certain analogy between this mimicry and that of the Indian Drongo cuckoo (*Surniculus dicruroides*), held to be parasitical in the nest of the common king crow (*Dicrurus macrocircus*), the black plumage and forked tail of which it assumes. So close is the resemblance between the two birds that, as Jerdon says, "the foster parents would hardly be undeceived even when the bird had arrived at maturity." The king crow is the most jealous of birds, and with loud cries chases away every stranger that approaches. In the one case the mimicry is adopted to terrify and repel; in the other to pacify and conciliate.

The numerical predominance of the male bird seems undoubted, leading to the association of several males with one female. There must be considerable difficulty in finding the required number of nests, in exactly the right stage, especially if the eggs, as held by Otto Herman and others, number, as a rule, from eleven to twelve, and may reach twenty to twenty-two. If, as many believe, each hen confines herself to the nest of one particular species, for the insertion of her egg, the difficulty is greatly increased. Possibly all the males associated with one hen engage in the search, probably by watching motionless from a tree, a long process. The chances of a suitable nest being available when required would thus be multiplied.

There is such a charm about the advent of this spring visitor, whose welcome note heralds the most delightful period of the year, that it would be a cause of congratulation if one could banish all sinister reflections connected with it, and recognise in its aberrant habit only an instance of self-sacrifice in foregoing the pleasures of a domestic life, and in handing over the care of its offspring, for their own good, to strangers, as does the Anglo-Indian parent among ourselves. We may also reflect that, with the ultimate object of saving us from serious losses through the unchecked multiplication of certain insect pests, this bird does not hesitate to adopt a habit so liable to misconstruction, or shrink from incurring unpopularity such as to lead even to hostile demonstrations on the part of its own congeners, by assuming the garb of their worst enemy. We may also have to admit that the charges levelled against the female of encouraging too many followers of the opposite sex resolve themselves into a praiseworthy anxiety to avail herself of all possible assistance

and advice in starting her children in life, and selecting the most favourable openings for their future careers.

The present season, when the bird is with us, seems opportune for inviting attention to and discussion of these interesting problems from the points of view above suggested.

VII.—*Some Lessons from the Darwin Centenary.*

By JOHN H. LYELL, M.D.

(Read 13th February, 1910.)

The centenary of Charles Darwin, being coincident with the fiftieth anniversary of the publication of his famous book on the "Origin of Species," is a specially favourable opportunity for reviewing the progress of the great movement of scientific thought which is so closely associated with his name. This is made all the easier for us by the appearance of a large volume of commemoration essays by the leading experts of the day,* in which we are able to take a bird's-eye view of the present trend of evolutionary ideas in the various departments of knowledge. This work was undertaken at the suggestion of the Cambridge Philosophical Society, and was left in the hands of a committee of learned Professors and others, amongst whom were the well-known names of Mr. Francis Darwin (son of Charles Darwin), Professor Bateson, and Professor Sedgwick. The object, as stated in the preface, is to illustrate the far-reaching influence of Darwin's teaching on the progress of knowledge, and the present attitude of original investigators and thinkers towards the views embodied in Darwin's writings. That these purposes have been fulfilled it will be for the workers in the different fields of thought to judge. The wide range of Darwin's theory and method will be gathered from the fact that, besides a series of papers upon almost every branch of purely biological science, we have specialists in geology, psychology, moral philosophy, sociology, history, theology, philology, and physics, contributing their views upon the all-embracing concept of evolution. That such a variety of writers have all written luminously and convincingly could hardly be expected, but there is no doubt that not a few of these essays are memorable productions, and will remain as classical Darwinian literature for many years to come.

Taking this work then as our guide, let us enquire as briefly as possible what have been the most important developments of Darwin's own views during the last half century; and as I have already attempted an exposition of the main doctrines of organic

* "Darwin and Modern Science: Essays in Commemoration of the Centenary of the Birth of Charles Darwin and of the fiftieth anniversary of the publication of 'The Origin of Species.'" Edited for the Cambridge Philosophical Society and the Syndics of the University Press by A. C. Seward, Professor of Botany in the University, &c., 1909, Cambridge. At the University Press.

evolution before this Society, I may take these as understood in a general sense.

NATURAL SELECTION.

There is no doubt that one of the most important successors of Darwin in his own special line is the well-known Professor of Zoology in the University of Freiburg, August Weismann, a writer who has done more to establish and elaborate the doctrine of natural selection than any other of his contemporaries. The paper which he gives on "The Selection Theory" is a masterly exposition of his views on this subject, and is characterised by his habitual soundness of judgment and clearness of expression. To the old Darwinian position he remains true, viz:—That "evolution depends essentially on the cumulative augmentation of minute variations in the direction of utility;" and again emphasises the inadequacy of the Lamarkian principle of the transmission of acquired characters to account for the transformation of species. It is no spirit of combativeness, he says, that induces him again to take the field against this principle, but the conviction that, besides being undemonstrable, and scarcely theoretically conceivable, it is a hindrance and obstruction to knowledge, "since the facile explanation it apparently affords prevents our seeking after a truer explanation, and a deeper analysis." In passing, it may be pointed out that this attitude is now shared by probably the greater number of the best authorities in Germany and in this country. One of the most recent deliverances on the question is by Professor Thomson of Aberdeen, who, at the close of a most minute examination of all the arguments for and against the principle (forming Chapter VII. of his important work on "Heredity"*) states that "the scientific position in regard to the transmissibility of modifications should be one of active scepticism, as there seems to be no convincing evidence in support of the affirmative position, and a strong presumption in favour of the negative."

Falling back upon Darwin's conclusion that transformations take place by minute steps, Weismann enters at considerable length into the question whether the insignificant deviations, which we know as individual variations, can form the beginning of a process of selection. There is no doubt that this difficulty has always been a formidable one, and it was fully realised and dealt with by Darwin himself in Chapter IV. of the "Origin of Species." Weismann, however adduces several very beautiful examples to show the importance of even the most minute features in the anatomy of various animals in securing their adaptation to the environment in which they are placed, and how even a microscopic variation in these features might

* "Heredity"—J. Arthur Thomson, M.A., Regius Professor of Natural History in the University of Aberdeen. 1908.

at once decide the survival or elimination of individual species. The delicate skeletons of the Radiolarians, for instance, have recently been shown to possess a selective value, in as much as the long silicious processes thrown out by these organisms, by increasing their contact with the water particles, prevent them from sinking into the deeper and colder layers of the ocean, where their continued existence would be impossible. Differences in the length of these processes at once determine which of the organisms will float and which will sink, and these differences or variations must, in the first instance, have been minimal in degree, and yet have possessed the required selective value.

Passing on to consider how the necessary beginnings of a useful variation are always present, and how, if these initial stages do not possess selective value, they eventually acquire it, Weismann proceeds to give an account of his theory of germinal selection, which is an attempt to formulate the more intimate processes giving rise to variations and their augmentation, in terms of the ultimate units of cell structure. He conceives a struggle for existence to be continually going on amongst the minute components of the germ-plasm, and as these components lose or gain in nutrition, so variations arise in the parts of the organism which they determine; whereupon, general or personal selection, as he calls it, steps in, and makes use of the primary variations thus created.

The fluctuations within the germ-plasm, says Weismann, form the basis of all hereditary variation, and supply the "stones out of which personal selection builds her temples and palaces," thus bringing about the adaptation of the organism to its environment.

The chief objections to the theory of germinal selection have been dealt with by Professor Thomson in his work on "Heredity." To say that it is unsupported by experimental evidence, that it is removed from the field of verification, that it is visionary and fanciful, and so on, is no criticism at all, says Thomson, because the same remarks would apply equally well to many of the accepted symbolic interpretations in chemistry and physics, where the behaviour of hypothetical atoms and molecules, electrons and corpuscles, is pictured in very much the same way as the interaction of Weismann's determinants and biophors. It is not necessary to follow Thomson in his discussion of the merits of the theory, but his acceptance of Weismann's own answers to objectors as sufficient and convincing is a valuable testimony in its favour from one who has shown himself deeply conversant with every aspect of the subject of heredity.

Weismann concludes his paper with a reiteration of the all-importance of adaptation, and of his confirmed belief in the efficacy of the great principle of natural selection as the only guiding factor

in evolution. It is certainly a conclusion worthy of the most careful attention at a time when there seems to be a tendency to throw doubts upon the continued validity of the main position of orthodox Darwinism. How much of Weismann's conservatism may be due to the failings of age (for he is now a man long over 70) it would be hard to say. But in any case we will do well to pause and weigh very carefully the speculations of the newer school of biologists before we allow them to bias our minds against the tried doctrines of the great masters of the past.

These remarks are perhaps not uncalled for, as we turn to consider for a moment the paper which follows next in order, viz., that entitled "Variation," by the famous Professor of Botany in Amsterdam, Hugo de Vries. The name of this writer is chiefly associated with what is known as the Mutation theory, of which he is the author, and with his brilliant discovery of the work of the Abbot Mendel, which is now embodied in the much discussed doctrine of Mendelism. It will be necessary to consider both of these theories, as they have a very important bearing upon the present position of Darwinism, and its probable developments in the future.

THE MUTATION THEORY.

We have already seen the great importance which Darwin and Weismann place upon the operation of selection upon small individual variations, leading to the slow change of old species into new types. De Vries now steps in and says, "In contradiction to this conception, the theory of mutations assumes that new species and varieties are produced from existing forms by sudden leaps." Mutations are thus distinguished from variations in being unexpected and saltatory changes in the organism, either in the disappearance of a character formerly possessed, or the cropping-up of one which was once prominent in more or less remote ancestors, or in the production of an apparently quite new character not known to have existed in the ancestors; such characters being further distinguished by their capacity of breeding true during succeeding generations. Variations in the old sense de Vries terms fluctuations. It is normal, he says, for organisms to fluctuate to and fro, oscillating round an average type, but these fluctuations are not observed to produce anything quite new. In contrast to these we have the so-called sports or mutations, which occur intermittently, and at once constitute new species. According to de Vries, therefore, the origin of species is by mutation, instead of by the gradual selection of fluctuations. When a mutation has appeared a new species is already in existence, unless all the progeny of the mutation are destroyed by the action of natural selection. The phrase "survival of the fittest" ought therefore to be

replaced by "survival of the *fittest species*." "Natural selection," says de Vries, "may explain the survival of the fittest, but it cannot explain the *arrival* of the fittest."

It might be expected that conclusions of such a far-reaching character would be based upon a wide survey of the animal and vegetable kingdoms, and supported by an accumulation of observations which would bid defiance to criticism. We find, on the contrary, that de Vries draws his facts from a somewhat narrow line of investigation, running entirely within his own special province of botany. It was the discovery of a remarkable growth of the evening primrose, in a deserted potato field near Amsterdam, that first brought the phenomena of mutation within the range of systematic observation. This plant was noticed to display an extraordinary tendency to produce freaks and sports, and in the course of ten years it was discovered that, amongst these, two well-defined new forms had differentiated themselves and become permanent occupants of the field. Taking specimens of these new species, and transplanting them to the Botanic Gardens at Amsterdam, de Vries found that they bred true when self-fertilised, and that they gave rise to still further new forms—the changes again occurring by sudden leaps and bounds, and not by any gradual process of development. Such new forms he designates "elementary species," in distinction to the mere varieties which arise out of fluctuating variations. The latter are not constant in their nature or transmission, but are continually at the mercy of selection, while elementary species remain true to themselves, and do not regress to the old mean.

It was the belief of de Vries that in these phenomena he had the privilege of witnessing the origin of new species taking place under his very eyes, and that in a similar manner all species whatsoever have arisen in the past. It will be questioned whether such a huge generalisation is justifiable, even upon theoretical grounds. The most obvious criticism of his theory is that after all it contains very little that is new, because he fails to make it clear that there is any essential distinction between variations and mutations. They must ultimately be merely different degrees of the same phenomenon, since it is impossible to draw the line between large fluctuations and small mutations. The real test of the theory, however, as Weismann shows, lies in its bearing towards the question of adaptation. How, he says, is it to be conceived that chance mutations can explain the extraordinary nicety with which innumerable species of plants and animals fit into their environment? How could the leaf contour and markings of the wings of mimetic butterflies, not to speak of the correlated instinct of folding the wings in such a way as to complete the illusion, have arisen by a sudden sport of nature? How could

the luminous organs and projecting eyes of deep-sea animals, so obviously adapted to the requirements of their existence, be attributed to the mere fortuitous occurrence of useful mutations? The only explanation of all such purely utilitarian modifications is to be found in the "gradual, simultaneous, and purposive variation of all the parts," under the guidance of natural selection, yielding as a final result the carefully moulded structure, which enables the organism to fit exactly into its niche and fulfil all the ends of its being.

MENDELISM.

Turning now to the question of Mendelism, we have a very important discovery which throws light on some of the most obscure phenomena of heredity.

Mendel's experiments were conducted with the edible pea (*Pisum sativum*), his object being to find out the laws of inheritance in hybrid varieties. The plant which he selected was specially suitable for the purpose, owing to its possessing constant differentiating characters, and admitting of easy artificial pollination. The hybrids were also readily fertile, and capable of being easily protected from the influence of foreign pollen. It occurred to him to take a series of conspicuous characters in the plant and make a study of how these characters behaved themselves in successive generations. He noted, therefore, such peculiarities as length of stem, whether long or short; colour of flowers, whether coloured or white; the form of the ripe seeds, whether smooth or wrinkled; and so on, there being always one pair of contrasted characters, for example—tallness or shortness, colour or no colour, etc. He now set about the production of his hybrids, by fertilising a plant bearing one character with the pollen of another plant bearing the contrasted character, a tall plant, for example, being crossed with a dwarf one, and so on. The first result was striking, namely, that the hybrids showed only one of the contrasted characters to the exclusion of the other, no intermediate forms being produced,—the tall plants, after crossing, only producing tall plants, and no dwarfs or medium varieties appearing. To the character that thus overshadowed the other he gave the term "dominant," and to the one which was apparently lost the term "recessive."

His next move was to allow the hybrids to become self-fertilised; but the result was quite different this time, for the characters of both the original parents now appeared in the offspring in the proportion of 75 per cent. of the dominant character to 25 per cent. of the recessive character. It was evident therefore that the recessive character must have been present in the hybrids, although latent and unrecognisable, and this phenomenon he designates "segregation."

Starting off again with the third generation of dominants and recessives, a still further change became manifest; for the 25 per cent. of recessives all bred true, giving rise, that is to say, to a line of pure recessives; while the dominants again split themselves into two sets, one set breeding true and only producing dominants, the other set behaving like the original hybrids, and yielding a mixed offspring of dominant-like forms and pure recessives. These two sets occurred in the proportion of 1 to 2. The alternation of the two phenomena of segregation and redistribution of characters could of course be carried on indefinitely, and by using three characters instead of two, a still further complexity of results could be brought about.

It is unnecessary, however, to follow out the elaboration of these laws, as their bearing upon the main question of organic evolution has less to do with the mathematical element which they contain, than with two important principles of hereditary transmission which they reveal. In the first place, Mendelism appears to demonstrate, in the words of Bateson, that "the characters of living things are dependent on the presence of definite elements or factors, which are treated as units in the processes of heredity. These factors can thus be recombined in various ways. They act sometimes separately, and sometimes they interact in conjunction with each other, producing their various effects. All this indicates a definiteness and specific order in heredity, and therefore in variation." In the second place, it also follows from Mendel's law that the origin of an apparently new species may occur by operation of the law of heredity quite apart from any slow accumulation of variations under the influence of natural selection, and that this emergence of a new form may take place suddenly in the manner of a sport or mutation, which will continue to breed true and remain independent of the swamping effects of intercrossing. Mendelism thus admirably coincides with the mutation theory, and at the same time gives to it a rationale and further confirmation from facts.

The importance of these theories of Mendel and de Vries will best be gathered from reference to the Darwin commemoration essays. We have already seen that Weismann holds still to the orthodox Darwinian position of the all-importance of minimal fluctuations. He will have nothing to do, in fact, with any origin of species by mutation, and points out that the conclusions of de Vries rest upon a very insecure foundation, inasmuch as the plant with which his experiments were conducted was not, as he assumed, a wild species, but in all probability a mere hybrid form and not existing anywhere in free nature. Bateson, on the other hand, is enthusiastic in favour of the mutation theory, and considers that from the moment when Mendel's work was made thoroughly known, a new era began, not

only in the problem of the origin of species, but in all the great problems of biology. Mr. Scott, President of the Linnæan Society, in a long paper on the Palæontological Record in Plants, quotes (with some reservation of opinion) the view of two distinguished French authorities, "that the facts of fossil botany are in agreement with the sudden appearance of new forms, differing by marked characters from those which have given them birth." Professor Loeb, of the University of California, at the close of his communication on "Experimental Study of the influence of Environment on Animals," remarks that "the discovery of de Vries that new species may arise by mutation, and the wide if not universal applicability of Mendel's law to the phenomena of heredity, must for the time being, if not permanently, serve for a basis of theories of evolution." Loeb's extraordinary experiments upon the effects of various physical and chemical agencies on the eggs of sea-urchins and other marine animals are well known, and the account which he gives of them in his paper is of surpassing interest. It almost reads like a romance when he tells us that by altering the composition of sea-water he was able to fertilise sea-urchins' eggs by the sperm of various kinds of star-fish, brittle-stars, and holothurians, the hybrids developing as well and living as long as the pure breeds of the sea-urchin; when he tells us further that he has proved within the last ten years that living larvæ can be produced by chemical processes from the unfertilised eggs of sea-urchins, star-fish, and indeed of all forms of animals with which experiments have been tried long enough; or when he describes the artificial production of twins by placing fertilised eggs in various solutions, and the fusion of double organs (such as the eyes of fish-embryos being changed into a single cyclopean eye) through the addition of magnesium chloride to the sea-water. These and other results undoubtedly give encouragement to the idea that the experimental biologist may eventually be able to produce mutations by physico-chemical means; and for the moment they at least suggest the possibility that in former periods of the earth's history, when the composition of sea-water may have differed from time to time, and other changes of environment may have taken place, the conditions were present which would afford the stimulus necessary to the sudden appearance of new forms.

THE DESCENT OF MAN.

Turning now to the question of human origins, which is dealt with in the long and interesting paper by Professor Schwalbe, we have the authority of a well-known expert for the view that all the more essential additions to our data since the publication of Darwin's "Descent of Man" go to strengthen the hypothesis of the pithecoid

origin of the human race. I have already devoted a paper to the contention of Klaatsch and others that the roots of our species are to be found, not amongst any of the families of the apes, living or extinct, but lower down amongst the primitive Eocene mammals, and it is only necessary to point out that Schwalbe opposes this view on the ground that it affords no explanation of the many undoubted points of resemblance between the anatomy of man and that of the apes. The younger school of anthropologists appear to have a difficult task before them if they wish to supersede the orthodox Darwinian doctrine of man's origin with the more flattering theory that mankind forms a fundamental branch of the great mammalian tree, as ancient as, or perhaps more ancient than, the family of the apes. All who are interested in the question of human evolution will await the further development of this controversy with much interest.

EVOLUTION AND SOCIOLOGY.

Passing now from the question of man's physical evolution, let us proceed to consider very briefly the much wider and more complicated subject of the bearing of natural law upon man's higher relationships in civilised society. The opening sentence of the essay on "Darwinism and Sociology," by M. Bouglé, states the problem as follows:—"How has our conception of social phenomena and of their history been affected by Darwin's conception of nature and the laws of its transformations?" It is impossible to follow the author of this essay in the somewhat discursive criticism which he offers of various applications of the Darwinian theory to human society, and we shall rather confine ourselves to a few plain issues suggested by some of the points which we have already had under discussion to-night. It may be mentioned, in passing, that there are certain thinkers who consider that the application of the laws of natural science to society is misleading. But, taking it for granted that there is, as most people believe, an analogy between the sphere of man's physical life and that of his social activities, a serious complication meets us at the very outset. The parallelism of biology and sociology is by no means complete, for the simple reason that we have a totally incommensurable factor to consider when we enter the human sphere, namely, the higher consciousness of man, which enables him to understand and, in many cases, elude or even annul the action of natural law. Let us take, for example, the law of natural selection or the survival of the fittest, and see how it works out in human affairs.

It will be at once apparent that the higher in civilisation we go the more emphatically has man seen it to be his duty to fight against this law, and in every way possible to evade its beneficial action

The whole of our vast modern philanthropy is directed towards the end, not of assisting in the elimination of the unfit, but of preserving the waste products of humanity, which in a state of free nature would be swept away as cumberers of the ground. Now we must refuse to believe the specious contention that in this way harm is being done to the race, the corollary to which would be the shutting-up of all our infirmaries and asylums, the repeal of our Poor Laws, and the dismissal of our medical officers of health. Is it not rather the case that we have a higher principle at work here, for what proceeds from man's sense of brotherhood and desire to relieve suffering and prolong life cannot be detrimental to his true progress, however contrary to the brute laws of nature it may seem to be? Romanes has pointed out in another connection that nowhere do we ever meet with such a thing as an instinct pointing aimlessly, and it will be seen on closer examination that what appears to be a direct contravention of the law of natural selection is really an unconscious expression of the fundamental principle of mutual aid, a principle of which we have foreshadowings even in the animal world. Darwin long ago showed how the social instincts of primitive man assisted him to rise out of a state of savagery, and although Darwin fully recognised the tendency of modern philanthropy to check the process of elimination, he also showed most emphatically that if we were to reverse our methods, and intentionally neglect the weak and helpless, "it could only be for a contingent benefit, with an overwhelming present evil."

We have also come to recognise that by preserving those who are apparently unfit we often indirectly gain advantages which more than compensate for immediate ills, and we find that after all there are other checks which come into operation and prevent the law of selection from falling into abeyance. It is evident, for example, that many individuals who are feeble in infancy turn out healthy and vigorous in adult life, or exhibit mental endowments of the highest value to the race. On the other hand, the weaklings whom we assist to survive do not marry and propagate so freely as the sound, and thus diseased or degenerate stocks gradually die out by a natural process. Speaking about disease, it must also be remembered that a great number of the ailments and frailties which we treat in institutions are not hereditary, either in themselves or in the constitutional conditions of which they may be the outcome. Besides, as Clifford Allbutt has remarked, "Of all the discriminating agencies to produce the survival of the fittest, disease is the worst, for the injury to those that survive is so serious that all measures which combat disease tend to improve the race."

Looking at the whole subject, therefore, from a broad point of

view, we must come to the conclusion that the well-being of the race is better served by allowing all the higher impulses of human sympathy and mutual helpfulness to have full scope, than by abandoning the race to the tender mercies of natural selection. Whatever his remote origin may have been, man has attained to a nobler estate than the beasts that perish, and his destiny is being shaped by infinitely higher laws than those under which the whole lower creation groaneth and travaileth in pain together until now. The great conception of evolution receives a deeper and wider meaning by including man within its scope, not because we bring man down within the narrow range of its known laws, but because we recognise that man's progress upwards and onwards, out of the baser limitations of his physical nature to the boundless possibilities of his moral and spiritual life, is in virtue of a different and more complex order of forces of which we are only beginning to discern the full significance. It would be impossible at this stage to follow these interesting speculations any further. "They enable us," however, as M. Bouglé says at the close of his paper, "to estimate the extent of the field of influence of Darwinism. . . . . The questionings to which it has given rise have proved no less fruitful than the solutions it has suggested. In short, few doctrines in the history of social philosophy will have produced on their passage a finer outcrop of ideas."

CONCLUSIONS.

In this paper I have only been able to touch upon a few of the vast problems which have been opened up during recent years by the ever expanding and still impregnable doctrine of evolution. It will have been abundantly evident, I think, that the difficulties which Darwin set himself to solve have not decreased in magnitude. The validity of some of the old positions has been seriously challenged, and new theories have been introduced, which only serve to increase the complexity of the issues involved. We have seen how the more conservative thinkers hold fast by the original idea of Darwin that species arise by slow and minute changes, while the more advanced school place great importance upon the sudden emergence of markedly divergent forms which are able at once to establish themselves and thus very much shorten the process of evolution. The possibility of the origin of species by mutation and the significance of the Mendelian laws of heredity are two subjects which will long continue to exercise the minds of experts. The great controversy regarding the inheritance of acquired modifications is by no means settled, but it may be considered a marked sign of the times that biologists are now leaning more and more to the negative position. As regards the origin of man, the balance of

opinion is strongly in favour of an ancestry derived from ape-like forms; but some eminent authorities incline to trace man's derivation to a much more remote branch of the great mammalian tree than the ape family. Finally, we have perhaps the greatest possibilities of all in the comparatively young science of sociology, which bids fair to eclipse all other branches of biology in the rapidity of its development and the daring speculations of its devotees.

For us, as simple students of nature, it is perhaps best to stand aside from the clangour of controversy and the theorising of specialists, content to wait till definite advances in knowledge are recorded before committing ourselves to immature doctrines. The fascinations of speculative biology ought not at least to lead us away from the patient observation of the living organism under our eyes, for it is only there after all that we can ever hope to gain a true insight into the infinite beauty and mystery of nature's laws.

> "Theory, friend, is old and grey,
> And green the golden tree of life."

VIII.—*Some Coleoptera of Kinnoull Hill.*

By W. E. Sharp, F.E.S.

[Read 20th January, 1910.]

A recent visit to Perth afforded me, at the suggestion of Mr. Rodger of the Museum, the opportunity of some slight exploration of the Coleoptera of the Wood and Hill of Kinnoull, nor is it necessary to say with what pleasure the English Coleopterist, whose experience of Scots beetles, their collecting and localities, was of the slightest, thus touched the fringe of the fauna of the North.

The September morning gave promise of a fair day, but the steady rain which set in about mid-day and continued till the evening rendered more than two or three hours' collecting impossible.

Only one method of capture was adopted—the gathering, pulling asunder, and shaking through a sieve on a large sheet of strong paper of the thickest, longest, and wettest moss that the woods afforded.

The results may possibly be of sufficient interest to record, as follows, in detail:—

Leistus rufescens, F. Generally distributed.

Calathus micropterus, Duft. Unknown in South of England. Except on this occasion I have only taken it on the bare heather-covered hills of Wales. A sylvan locality seems unusual, but there is plenty of heather in the wood, in the moss under which these beetles lay concealed.

Trechus minutus, F. Generally distributed over the United Kingdom. More abundant in the north.

Pterostichus nigrita, F. Generally distributed over the United Kingdom.

Tachinus proximus, Kr. Quite a boreal species, only known from the extreme north of England. A not uncommon Scots species. I had never encountered it previously.

Tachyporus obtusus, L.
Mycetoporus splendidus, Grav.
Homalota sylvicola, Fuss.
„ longicornis, Grav.
} Generally distributed throughout United Kingdom in similar localities.

Homalota eremita, Rye. Generally a northern and mountain species, but there are a few records from Delamure Forest in Cheshire.

Philonthus politus, F. Generally distributed and nearly always to be found under heather in woods.

Homalota atramentaria, Gyll. Generally common in the north of England, and very abundant in the highlands of Wales.

Homalota fungi, Grav. Abundant everywhere.

Othius myrmecophilus, Kies.
Quedius nigriceps, Kr.
} Generally distributed in woods throughout United Kingdom.

„ umbrinus, Er. A species of western and northern range in United Kingdom: Devonshire, Wales, Cumberland, and Scotland. Absent or very rare east and south.

Anthophagus testaceus, Grav. A typically Scots species, unknown in England (except the extreme north) or Wales. I had never previously seen it alive.

Stenus impressus, Germ.
Homalium excavatum, Steph.
*Philonthus nigritulus, Grav.
} Common and generally distributed throughout United Kingdom.

Megarthus sinuatocollis, Lac. With a wide range in the United Kingdom, but local, and nowhere very common.

Balaninus salicivorus, Payk. Generally distributed on cruciferous plants.

* This is the P. trossulus of British Collections.

IX.—*Notes on Some Ectoparasites in the Museum, Perth.*

By James Waterston, B.D., B.Sc.

[Read 10th February, 1910.]

Through the kindness of Mr. A. M. Rodger, an opportunity has recently been given me of examining the parasites of birds and mammals in the collections under his charge. These creatures have only been casually acquired, yet amongst them there are two species of more than ordinary interest, viz., *Braula cæca*, N., and *Trichodectes crassus*, N., of whose precise status in Scotland little seems to be known.

The collection is a small one, comprising less than a dozen species, belonging, with one exception, to the order Insecta. The single Tick represented has been determined by Prof. G. H. F. Nuttall, F.R.S., to whom my best thanks are due.

ACARINA.

Ixodes ricinus, L.

5 males and 5 females, adult. Wild Cat (*Felis catus*, L.), Sutherland. Taken by Mr. Geo. Hart, 1903.

2 females, adult. Sheep, Perth. Taken by Mr. Geo. Hart, 1903.

Female, adult. Red Deer (*Cervus elaphus*, L.), Breadalbane. Taken by Mr. Thomas Crawford, 3rd October, 1898.

Female, adult. Dog. Obney Farm, Bankfoot, Perthshire, 3rd August, 1904.

Male, female, and nymph. Roe Deer (*Capreolus caprea*, Gray). Perthshire. Mr. G. Hart, 1903.

Mr. Wm. Evans, F.R.S.E., has recorded this species from the vicinity of Callander (on the udders and legs of cows), and, unattached to the host, has taken the female near Aberfoyle, and the adult male near Killin (*Ann. Scot. Nat. Hist.*, 1907, p. 35).

DIPTERA.

Hippoboscidæ.

Stenopteryx hirundinus, Leach. Male. "Swallow." Taken by Mr. Geo. Hart, Perthshire, 25th June, 1903. [I find this species generally in house martins' nests (*Chelidon urbica*, J.W.)].

Lipoptena cervi, L.

4 wingless males and 2 females in same condition, also 2 females which have not yet shed their wings. Red Deer (*C. elaphus*), Breadalbane. Taken by Mr. Thomas Crawford, 3rd October, 1898.

Male, wingless. Roe Deer (*Capreolus caprea*, Gray), Perthshire. Taken by Mr. Geo. Hart, 1903.

2 males, 5 females, wingless. Red Deer (*C. elaphus*), Perthshire. Taken by Mr. Geo. Hart, October, 1909.

Melophagus ovinus, L. Male and 5 females. Sheep, Perthshire. Taken by Mr. Thos. Crawford, 1st October, 1898.

Braulidæ.

Braula cæca, Nitzsch. Mr. Hutchison found three examples of this curious parasite on a queen bee (*Apis mellifica*, L.), Perth, 23rd September, 1907. From the worker he has never taken more than one at a time. This seems to be the general experience. The only other Scottish specimen of Braula that I have heard of is in the collection of Dr. J. H. Ashworth. It is on a slide prepared some years ago by the late Mr. James Simpson, of the Anatomy Department, Edinburgh University. Although without data there seems to be no reason for doubting its native origin.

SIPHONAPTERA.

Ceratophyllus styx, Rothsch. Nest of *C. riparia*, near Perth. Both sexes abundant. 4th October, 1909. F. Smith.

[The following fleas have been recorded from the Tay area:—*Pulex irritans*, L.; *Spilopsyllus cuniculi*, Dale; *Ceratophyllus gallinæ*, Schrk.; *C. fringillæ*, Rothsch.; *C. gallinulæ*, Dale; *C. agyrtes*, Heller. (See *Ann. Scot. Nat. Hist.*, 1906, October, pp. 211-214; *Ibid.* 1910, July, p. 184; and *Proc. Roy. Phys. Soc. Edin.*, 1910, pp. 86-89)].

MALLOPHAGA.

Ornithobius cygni, L. Numerous on *Cygnus musicus*, Port-Allen-on-Tay, January, 1909. A. M. Rodger. *Ann. Scot. Nat. Hist.*, January, 1910, p. 58.

Ornithobius goniopleurus, Denny. Mr. Rodger has taken 9 examples of this interesting parasite from the Canada Goose (*Bernicla canadensis*) at Perth on 12th February, 1910. Of these one male only is adult, three females are nearly mature, while the remainder are at much earlier stages. In none are the black dorsal markings completely established; indeed, (except in

the male) only the edges of the abdominal segments are darkened. It was, I think, from immature examples like these that Denny constituted his **Atromarginatus*, now relegated to the status of a synonym.

Goniopleurus and *cygni* are not likely to be confused, for, apart from the character and disposition of their abdominal markings, certain of their morphological features are very distinct. The male genitalia and antennæ are contrasted in the accompanying figures.

I., III.—Cygni. II., IV.—Goniopleurus.

Trichodectes crassus, N. There is a nice series, 6 males and 18 females (2 immature), of this insect from the Badger (*Meles taxus*, L.). Taken by Mr. Fred. Hart, 15th January, 1910.

I take this opportunity of recording

Trichodectes latus, N. Both sexes, adult, with other immature examples, on nursing puppies, Duncrievie, Glenfarg, 16th July, 1909. Forwarded by Mr. J. W. M. Adamson.

The collection contains also Mallophaga from Barn Owl, Guillemot, and Domestic Fowl. But I think it better to postpone notice of these examples till I have made a fuller study of the group.

* Piaget (Les Pediculines, I., p. 378) discusses this species under *Cygni*. "Je ne crois pas qu'il faille conserver comme espèce distincte l'Or *atromarginatus* de Denny provenant d'un *Cygnus canadensis*. (Anop. p. 185, tab. xxiii., f. 3.) La seule différence, si l'on peut s'en rapporter à la figure, consiste en ce que le 3e art. de l'antenne serait plus large à l'extrémité, et les points noirs de l' abd. seraient ici la bande laterale entière." The latter character, however, clearly shown in Denny's figure, at once separates his insect from *cygni*. Piaget evidently knew *goniopleurus* only through Denny's description.

X.—*A List of Diptera Collected in Perthshire.*

By A. E. J. Carter.

(Read 14th April, 1910.)

On sending some flies recently to the Perth Museum, I was rather surprised to hear from Mr. Rodger that 58 species, out of the 79 sent, were new to the collection, and I was still more surprised when, at his suggestion, I drew up the following list of dates and localities, and found that many species, common and widely distributed in the County, had not yet been recorded. It is true the Diptera of Scotland are still very inadequately known, but as Perthshire has long been a favourite collecting ground, and many scattered papers and notes dealing with its fauna exist, I was not quite prepared to find so many of my species unrecorded.

In Mr. Grimshaw's "Diptera Scotica," Parts I., III., and V., (*Annals of Scot. Nat. Hist*, 1899, 1903-04, 1906), and in papers by the present writer (*Ent. Mon. Mag.*, 1905-1909), records of many of the species here noticed will be found.

Species in the following list marked * are new to the museum collection; those marked § are new records for the County—at least there are no records in the literature to which I have access.

MYCETOPHILIDÆ.

*Mycetophila punctata, Mg. A common species. Aberfoyle and Blairgowrie.

Mycetophila signata, Mg. Aberfoyle: Sept.

LIMNOBIDÆ.

*§Rhypholophus varius, Mg. Aberfoyle: Aug. '06.

*Erioptera flavescens, Mg. Aberfoyle: August.

TIPULIDÆ.

*Pachyrrhina histrio, F. Blairgowrie, Comrie, etc: July.

STRATIOMYIDÆ.

Microchrysa polita, L. Blairgowrie and Comrie: July.

*Beris vallata, Forst. Blairgowrie and Comrie: July.

,, chalybeata, Forst. Blairgowrie: July.

EMPIDÆ.

*Hybos grossipes, L. Aberfoyle, Blairgowrie, and Comrie: June and July.

*Cyrtoma spuria, Fln. Aberfoyle, Blairgowrie, and Comrie: July-September.

*Rhamphomyia variabilis, Fln. Aberfoyle and Blairgowrie: August and September.

DOLICHOPODIDÆ.

*Dolichopus atripes, Mg. Aberfoyle, Blairgowrie, and Comrie: June, July.

*Dolichopus atratus, Mg. Aberfoyle and Comrie: July.

* ,, picipes, Mg. Comrie; July.

* ,, discifer, Stan. Aberfoyle, Blairgowrie, and Comrie: June and July.

*§Dolichopus popularis, W. Blairgowrie and Comrie: July.

* ,, signatus, Mg. Aberfoyle and Comrie: July and August.

*§Dolichopus urbanus, Mg. Blairgowrie and Comrie: June-August.

*§ ,, trivialis, Hal. Blairgowrie and Comrie: June, July.

,, ænus, Deg. Aberfoyle, Blairgowrie, and Comrie.

*§Hercostomus nigripennis, Fln. Aberfoyle, Blairgowrie, and Comrie: June-August.

*§Gymnopternus cupreus, Fln. Blairgowrie, Comrie: June, July.

* ,, ærosus, Fln. Aberfoyle, Blairgowrie, and Comrie: August.

Argyra argentina, Mg. Aberfoyle: July.

*Hydrophorus borealis, Lw. Aberfoyle: August.

*Liancalus virens, Scop. Aberfoyle and Callander: August and September.

*§Campsicnemus loripes, Hal. Aberfoyle: September, '05.

PIPUNCULIDÆ.

*Pipunculus campestris, Ltr. Aberfoyle: August.

SYRPHIDÆ.

Chilosia antigua, Mg. Aberfoyle, Blairgowrie, and Comrie: June and July.

Platychirus albimanus, F. Aberfoyle, Blairgowrie, Callander, and Comrie.

Melanostoma mellinum, L. Common most places.

*Ischyrosyrphus glaucius, L. Aberfoyle, Blairgowrie, and Comrie: July.

*§Syrphus grossulariæ, Mg. Blairgowrie, Comrie, Kirkmichael July.

Syrphus cinctellus, Ztt. Aberfoyle, Blairgowrie, Comrie: July.
,, cinctus, Fln. Aberfoyle, Blairgowrie, Comrie; July.
,, compositarum, Verr. Aberfoyle, Blairgowrie, Comrie: July.
Volucella bombylans, L. Aberfoyle, Blairgowrie; July.
Eristalis pertinax, Scop. A common species.
,, rupium, F. Aberfoyle, Comrie, Kirkmichael: June and July.
Xylota segnis, L. Aberfoyle, Blairgowrie, Comrie, Kirkmichael.
Sericomyia borealis, Fln. Aberfoyle, Blairgowrie, Callander, Comrie, Kirkmichael: June to September.
Chrysotoxum arcuatum, L. Aberfoyle, Blairgowrie, Comrie: June, July.

TACHINIDÆ.

Micropalpus vulpinus, Fln. Aberfoyle: July to September.
* ,, hæmorrhoidalis, Fln. Blairgowrie: August, '08.
*Myiocera carinifrons, Fln. Aberfoyle: July to September.

MUSCIDÆ.

*Morellia simplex, Lw. Aberfoyle, Blairgowrie, Comrie, Callander: June to September.
Mesembrina meridiana, L. Aberfoyle, Blairgowrie, Callander, Kirkmichael: July to September.
*Pyrellia cyanicolor, Ztt. Aberfoyle, Blairgowrie, Comrie, Kirkmichael: July to September.
*Protocalliphora grœnlandica, Ztt. Aberfoyle, Callander, Kirkmichael: July to September.

ANTHOMYIDÆ.

*§Hyetodesia variabilis, Fln. Blairgowrie: June and July.
* ,, semicinerea, W. Aberfoyle, Biairgowrie, Comrie, Kirkmichael.
*§Hyetodesia errans, Mg. Blairgowrie, Callander, Comrie, Aberfoyle: May to September.
*Hyetodesia signata, Mg. Aberfoyle, Blairgowrie, Callander, Kirkmichael; June to September.
Hyetodesia basalis, Ztt. Aberfoyle, Blairgowrie, Comrie: July, August.
*§Allœostylus flaveola, Fln. Aberfoyle and Comrie: July, August.
*Mydæa vespertina, Fln. Aberfoyle, Blairgowrie: August, September.
* ,, urbana, Mg. Aberfoyle, Blairgowrie, Comrie: June to September.

*Mydæa pagana, F. Aberfoyle, Blairgowrie, Comrie: June to September.

*Spilogaster nigrinervis, Ztt. Aberfoyle, Blairgowrie, Comrie: June to August.

*§Hydrotæa dentipes, F. Aberfoyle, Blairgowrie, Callander, Comrie: June to September.

*Hydrotæa similis, Mde. Aberfoyle, Comrie, Kirkmichael: July to September.

*Hydrotæa impexa, Lw. Aberfoyle, Blairgowrie, Comrie.

* ,, irritans, Fln. A common species.

*Ophyra leucostoma, W. Aberfoyle, Blairgowrie, Comrie: June, July.

*§Trichopticus hirsutulus, Ztt. Comrie and Kirkmichael: July.

*Hylemyia strigosa, Fln. A common species.

* ,, flavipennis, Fln. Aberfoyle and Callander: June to September.

Drymia hamata, Fln. Aberfoyle and Blairgowrie: July to September.

*§Pegomyia bicolor, W. A common species.

*Homalomyia aërea, Ztt. Aberfoyle and Comrie: July to September.

*§Azelia macquarti, Stæg. A common species.

CORDYLURIDÆ.

*Scatophaga suilla, F. Aberfoyle and Comrie: July to September.

*§Scatophaga maculipes, Ztt. Aberfoyle, Blairgowrie, Comrie: June, July.

*§Scatophaga squalida, Mg. Aberfoyle, Blairgowrie, and Comrie: June, July.

SCIOMYZIDÆ.

*Neuroctena anilis, Fln. Aberfoyle, Blairgowrie, Callander Comrie: June to September.

ORTALIDÆ.

*§Rivellia syngenesiæ, F. Comrie: July, '07.

LONCHÆIDÆ.

§Lonchæa vaginalis, Fln. Aberfoyle, Blairgowrie, Comrie, Kirkmichael: August, September.

EPHYDRIDÆ.

*§Notiphila cinerea, Fln. Blairgowrie: June to August.

PHORIDÆ.

*§Trineura aterrima, F. Blairgowrie and Comrie: June, July.

XI.—*David Douglas, Scone, Botanist and Pioneer of Arboriculture.*

By R. Dow.

(Read 14th April, 1910.)

David Douglas was born at Old Scone in 1799. His father was a stone mason, possessing unusual mental abilities. Even in early boyhood Douglas evinced a taste for rambling, and a fondness for objects of natural history was very strongly marked. The decided taste which he showed for gardening and collecting plants caused him to be employed at the age of eleven in the Scone Palace Gardens, Mr. Beattie being head gardener. Here he remained for seven years, his whole heart being devoted to the attainment of a thorough knowledge of botanical pursuits, which he so ardently followed in after life. While apprentice at Scone Palace Gardens, Messrs. R. & J. Brown, of the Perth Nurseries, were very intimate with Mr. Beattie, and their visits to Scone afforded the eager apprentice opportunities to gain their acquaintance. Both were good British botanists, and so fond of the study as annually to devote a part of the summer to botanizing in the Highlands; and from hearing them recount their adventures and describe the romantic scenery of the places they had visited in search of plants, Douglas secretly formed the resolution of imitating their example. Proud of his clever apprentice, Mr. Beattie recommended him to the gardens at Valleyfield, near Culross, the seat of Sir Robert Preston, a place then celebrated for its select collection of plants. Thither David Douglas went in 1818 at the age of nineteen, after having spent the preceding winter months at an evening school in Perth. At Culross a fresh impulse seized him, his mind becoming wholly bent on botany, more especially exotic plants, one of the best collections being then cultivated at Valleyfield. He had access, moreover, to Sir Robert Preston's botanical library, a privilege of the utmost value to one endowed with such faculties of mind and memory as he possessed.

His ambition growing with his knowledge, he gained admission to the Botanic Gardens, Glasgow. Here he became an ardent and diligent student at the botanic lectures of Dr., afterwards Sir, W. J. Hooker, then Professor of Botany in the University of Glasgow. It is needless to say that he became a favourite of the professor, who made him his companion in his botanical excursions in the Highlands and other parts of Scotland, for the purpose of collecting materials for his Flora Scotica. These excursions were the turning point in Douglas's career, for Professor Hooker was so struck by his

qualifications as a botanical collector that he recommended him to Mr. Sabine, then Secretary to the Royal Horticultural Society, London, as a botanical collector, and to London he directed his course accordingly in the spring of 1823.

David Douglas had now reached a most interesting period of his life, when he was about to undertake a long voyage and to explore remote regions hitherto untrodden by the foot of any naturalist. Far from the abodes of civilised society, frequently with no other companion than a faithful dog, or a friendly Indian as guide, we should have known little of his adventures were it not for a journal he kept with great care, and which has been deposited in the library of the Royal Horticultural Society.

In 1824 he left these shores for the Columbia River to explore the vegetable productions of the adjoining country and southward to California, of which scarcely anything was at that time known, although a glimpse of the forests of gigantic coniferæ covering the coast range had been obtained by Archibald Menzies a quarter of a century previous, when accompanying Vancouver on his interesting voyage. Douglas landed at Fort Vancouver, on the banks of the Columbia River, in April 1825. From that time till his return to England in 1827 he explored the botany of the surrounding country. He wrote a private journal of his wanderings and discoveries, which is still preserved in manuscript form in the Archives of the Royal Horticultural Society, the following being an extract from its opening pages :—

"Joy and expectation sat on every countenance as we anchored in Baker's Bay on the Columbia at four o'clock in the afternoon of the 7th of April, 1825. Thus terminated my long and tedious voyage of eight months and fourteen days. The joy of viewing land, and the hope of being able, in a few days, to range through this long-desired spot, and to resume my wonted pursuits and enjoyments, may be easily imagined. I think I may truly reckon this as among the happiest moments of my life. Next morning, on stepping on shore, I picked up *Rubus spectabilis*, *Gaultheria shallon*, with several other plants which had only been known to me in the Herbaria, or by name. Many species of *Vaccinium*, with *Tiarella* and *Heuchera*, both in full blossom, grew in the woods. My paper for preserving plants being all in the hold of the ship, I could do but little in collecting. Nothing gave me greater pleasure than to find *Hookeriana lucens* in abundance in the damp woods, growing with a plant whose name also reminded me of another valued friend, *Menziesia ferruginea*. From this period till the 12th of May, my labour was well rewarded by *Ribes sanguineum*, a lovely shrub, which grows abundantly on the

rocky shores of the Columbia, producing a great profusion of flowers, but little fruit. On the 5th September I reached the top of a distant mountain, after a laborious walk of fifteen hours, to find two new species of pines, *Abies nobilis* and *Abies amabilis*, the grandest trees of the tribe." This is the first mention in his journal of these two beautiful trees, whose names will for all time be associated with Douglas.

This is his account of his first discovery of *Pinus Lambertiana*: "Meeting a native one day, with my pencil I made a rough sketch of the cone and pine tree which I wished to obtain and drew his attention to it, when he instantly pointed to the hills fifteen miles distant. At mid-day, with the native for my guide, I reached my long-wished-for pines. New and strange things seldom fail to make strong impressions. The cones which hang from the points of the pendulous branches are like sugar loaves in a grocer's shop. These cones are only seen on the loftiest trees, and putting myself in possession of three, all I could find, nearly brought my life to a close. As it was impossible to climb or hew down the tree, I endeavoured to knock off the cones by shots from my gun, the report of which brought eight war-like Indians. Escape was useless, so I put myself in a position to fight for my life. They then signified they wished some tobacco; this I signified they should have if they fetched me a quantity of cones. They went off immediately. I picked up my three cones and some twigs and made the quickest possible retreat."

During these two busy years, 1826-27, Douglas introduced into this country no less than 160 plants. Many of these are common enough in our gardens, but few are aware that it is to David Douglas we owe them, *e.g.*, *Berberis aquilifolium*, *Clarkia elegans*, *Eschscholtsia Californica*, *Garrya elliptica*, *Heuchera micrantha*, *Mimulus cardinalis*, *Phlox speciosa*, *Ribes sanguineum*, *Spiræa aruncus*, and *Spiræa ariæfolia*. In the spring of 1827 he returned home for a well-earned holiday. Starting from Fort Vancouver, he set out on foot across the Rockies to Hudson Bay, where he met Captain (afterwards Sir John) Franklin returning from his second overland Arctic expedition, and with Sir John returned to England, bringing with him many of the results of his researches, including cones of *Abietia Douglasii*, *Pinus ponderosa*, and *Pinus Lambertiana*. He remained in this country two years, enjoying the pleasures of being fêted and lionised to his heart's content. But he soon tired of this, being of an over-sensitive temperament. He became restless and dissatisfied, and longed to get back to the more rugged but congenial pursuit of nature in her own grand solitudes. Productive as was the first mission of Douglas to the Western shores of North America, the second was undertaken under far more favourable auspices.

Reaching the Columbia River for the second time in June 1830, he spent the remainder of the year in exploration, making valuable additions to the pinetum, the most interesting being *Abies nobilis*, *Abies amabilis*, *Abies bracteata*, and *Abies grandis*, *Picea sitchensis*, *Pinus monticola*, *Pinus Sabiniana*, *Tsuga Albertiana*, and *Sequoia sempervirens*.

Writing on the 11th October, 1830, from the entrance of the Columbia River, he says, "I am transmitting one bundle of six species, exceedingly beautiful, of the genus *Pinus*. Among these is *Pinus nobilis*, by far the finest. I spent three weeks in a forest composed of this tree, and day by day could not cease to admire it, in fact, my words can only be monotonous expressions of this feeling. I have added one new species during this journey, *Abies grandis*, a noble tree growing two hundred feet high." Writing from Monterey, Upper California, November 23, 1831, he says, "My whole collection of this year in California may amount to 500 species. This is vexatiously small, I am aware, but when I inform you that the season of botanizing does not last longer than three months, your surprise will cease. Such is the rapidity with which spring advances on the table lands of Mexico and the plateaux of the Andes, that plants here bloom only for one day. Intense heat sets in in June and burns every plant to a cinder." He sent home 50 plants during that year, all of which were planted in Chiswick Gardens, including such well-known garden favourites, *Bartonia aurea*, *Godetia lepida*, *Limnanthes Douglasii*, *Lupinus latifolius*, *Nemophila insignis*, *Oenothera densiflora*. In 1831 he travelled southwards to California, then a comparatively unknown land; the gold rush did not take place till 1848, or 17 years later than Douglas' visit. He finally quitted Western America in 1833, having previously resigned his appointment as Collector to the Royal Horticultural Society, in consequence of a revolution in the affairs of the Society, which led to the resignation of Mr. Sabine, the Secretary, with whom Douglas identified his interests. He sailed for the Sandwich Islands, where he remained some months, when a deplorable accident terminated his life at the early age of 35. The natives of the Islands were in the habit of making concealed pits for capturing wild cattle. In one of his excursions, Douglas fell accidentally into one of these, in which an infuriated bull was already trapped; he was found dreadfully mangled and quite dead on July 12th, 1834. In 1847, thirteen years after his death, through the exertions of the late Archibald Gorrie, a public monument was erected to his memory, and now stands in the Kirk Yard of Scone, his native parish, bearing the following inscription:—

"1847.

"Erected by the lovers of botany in Europe in memory of David Douglas, a native of this parish, who, from an ardent

love of science and a desire to promote the improvement in botany, visited the unexplored regions on the banks of the Columbia and southward of California, whence he transmitted a great variety of the seeds of valuable trees and flowering plants, adapted to the climate of Great Britain, and who, after devoting ten years of the prime of life in adding to the Arboretum and Flora of Europe, suffered an accidental and lamented death in one of the Sandwich Islands, on 13th of July, 1834, in the 35th year of his age. Endowed with an acute and vigorous mind, which he improved by diligent study, this eminent botanist uniformly exemplified in his conduct those Christian virtues which invested his character with a higher and more imperishable distinction than he justly acquired by his well-earned reputation for scientific knowledge. A dutiful son, a kind and affectionate brother, a sincere friend, he secured by the rectitude of his moral and religious principles, not less than by the benevolence of his disposition, the esteemed regard of all who knew his worth."

The reverse of the tombstone is—

"The following are a few of the numerous trees, shrubs, and ornamental plants introduced by Douglas :—

TREES.

Acer circinatum.	Pinus Lambertiana.
Acer macrophyllum.	Pinus ponderosa.
Amelanchier Florida.	Pinus nobilis.
Arbutus procera.	Pinus amabilis.
Crataegus Douglasii.	Pinus Menziesii.

Pinus Douglasii.

SHRUBS.

Berberis aquifolium.	Ribes sanguineum.
Berberis glumacea.	Ribes speciosum.
Garrya elliptica.	Rubus spectabilis.

Gaultheria Shallon.

ANNUALS, BIENNIALS, AND PERENIALS.

Clarkia pulchella.	Gillia tricolor.
Clintonia elegans.	Nemophila insignis.
Collinsia grandiflora.	Ipomopsis elegans.

Lupinus poryphyllus.
Eschscholtzia Californica.
Douglasia nivalis, &c., &c."

There have been collectors who have contributed more to botanical knowledge, and collectors who have made more extensive collections, but none who have contributed more to the stock of hardy plants into Britain than David Douglas, Scone's illustrious son. He had the rare good fortune to be sent to a country which was at the time fertile in novelties, and what was of still more importance, one possessing a climate similar to our own.

Ever since the early decades of the last century, the gardens of Scotland, and more especially those of Perthshire, have been noted for their collection of conifers. The indigenous cone-bearing trees of Western America seem to find in our own country conditions more congenial to them than almost any other part of the British Isles, or even of Europe. No single garden or locality will ever be found to suit all conifers. Irrespective of hardiness, their requirements are too varied for that, but a climate with no great extremes of heat or cold, with abundant moisture, and never subject to long intense droughts, induces the luxuriant growth of a larger proportion of pines and firs than any other, and such a climate our own fair county seems to afford. The extensive seaboard of Scotland, the warming influences of the Gulf Stream, and the wide-extent of mountains are peculiarly adapted for conifers, which prefer moisture and an equable temperature rather than heat and intense sunlight.

A SHORT ACCOUNT OF THE CONE-BEARING TREES INTRODUCED TO BRITAIN BY DAVID DOUGLAS.

Pinus Lambertiana is an alpine tree growing in the Western States, from the Columbia River to Lower California, especially in the Cascades and Sierra Nevada. This, the loftiest of all pines, reaches to 300 feet, rivalling the *Sequoias*, with which it is associated; fine specimens are at Keir and Methven Castle. The sugar pine was discovered by Douglas in South West Oregon in 1826, and introduced to this country in the following year. He had previously seen one of its large cones, which had been brought to him by an Indian, and this induced him to make an excursion, which he conducted with safety, nearly losing his life, however, by hostile Indians. The specific name was given by Douglas in compliment to Mr. A. B. Lambert, a munificent patron of science, and the author of a beautifully illustrated folio entitled "The Genus Pinus."

Pinus monticola,—Western white pine—to distinguish it from *Pinus strobus*,—the Eastern white pine. The bark is distinctly broken into peculiar small square blocks, and no other tree associated with it has this bark character. The action of wind constantly tears off thin outer scales, and exposes the red-brown interior.

Pinus monticola was originally discovered by David Douglas in 1831, and introduced by him to the Horticultural Society's Gardens at Chiswick; but it was not distributed generally till a quarter of a century later, when a large number of trees were raised from seeds collected by Mr. Lobb, Veitch's collector, and Mr. Jeffrey, collector to the Scottish Oregon Society, between 1851 and 1855. Exceptionally fine specimens are to be seen at Scone Palace, the Cairnies, Keir House, Abercairney, and Murthly Castle; but some of the trees have unfortunately become infested with a destructive fungus, necessitating the felling of some of the finest specimens.

Pinus Sabiniana, the gray or digger pine, owes its common names to the pale green colour of its foliage, and to the fact that the large seeds furnish an important food to the Digger Indians of California. Its meagre foliage permits the big dark cones to be seen half a mile away. With the exception of the coulter pine, it produces the largest and heaviest cones of any two or three-needled American pine. They mature in the second season, remaining firmly attached to the branches for a number of years. The cones scale very slowly; the Indians hasten the opening by placing them in a small fire.

It does not form forests, and is so unlike any other pine in habit and aspect, that, even amidst the luxuriant coniferous vegetation of California, it forms a distinct feature of the landscape.

It was first discovered by Douglas in his first excursion to California in 1826, but his cones were unfortunately lost in crossing a stream on his return journey, and it was not till 1832 that seeds reached this country. Douglas gave it the name "Sabiniana" in compliment to Mr. Joseph Sabine, Secretary of the Royal Horticultural Society.

Pinus ponderosa, or western yellow pine, is one of the giants of Western America, its majestic size being surpassed only by the sugar pine, *Pinus Lambertiana*. This tree is easily recognised by its long three bundle needles, and by a peculiar characteristic of the cone in breaking away from the branch, viz., that some of the basal scales are left on the tree. It has probably the greatest range of all the American pines, thus naturally developing many forms. It first became known to science by Douglas in his first voyage, and seeds were sent home in 1827 and distributed among the fellows of the Royal Horticultural Society, including Lord Mansfield.

The variety *Jeffreyii* is a denizen of the mountain tops, and is named after Jeffreys, the Collector to the Scottish Oregon Association. Few objects in nature are more impressive than these two trees, especially the latter.

Abies nobilis forms large forests along upper slopes of the Cascade

Mountains of Oregon. It was first discovered by Douglas during his first mission to North West America, in 1825, near the Grand Rapids of the Columbia River, but it was not till his second mission, and during his excursion up Columbia River, in 1830, that he was able to collect seeds and send them to England. As an ornamental tree for the lawn, park and landscape, *Abies nobilis* ranks among the best of the silver firs; its dark green foliage, with its soft glaucous hue, heightened often to silvery whiteness by certain conditions of soil, at once arrest the attention. Its large handsome cones, which are produced freely even in young trees, are a striking ornament of the species. Numerous fine specimens scattered over Britain and Ireland attest its adaptability to the British climate. Among the finest individual trees worthy of special mention are at Dupplin Castle, Murthly Castle, Ochtertyre, and Scone Palace.

Abies amabilis, an alpine of the district over which *nobilis* is found, grows singly or in groves, or associated with *Tsuga albertiana*, *Abies nobilis*, *A. grandis*, or with *Pinus monticola*, *Tsuga mertensiana*, and *Abies lasiocarpa*. For many years the very existence of this tree as a distinct species was called in question in America. In Britain, however, belief in its existence never faltered. The little that is known of the discovery of *Abies amabilis* was communicated by Douglas to Sir W. J. Hooker by Douglas' friends three years after his untimely death. From this correspondence we learn that he first saw *amabilis* in September, 1825, on the top of a high mountain south of the Grand Rapids of the Columbia after a laborious climb. He, however, lost his specimens on the return journey. Many subsequent explorers failed to discover *amabilis*, and it was as late as 1880 that a party, under Dr. Engelman, rediscovered it on the ground on which Douglas, fifty-five years before, had discovered it for the first time. Steps were then taken for the importation of seed, and many young trees planted from this seed are reported to be thriving.

Abies bracteata is the most remarkable of all the silver firs. Its singular cones and its restricted habitat have invested it with an especial interest to botanists. Its only known habitat is on the western ridge of the Santa Lucia Mountains in South California. The original discoverer was the intrepid Douglas in his second or 1830 expedition, but he was unable to collect cones, and it was not till 1853 that William Lobb, collector for the famous firm of Veitch, obtained cones, and it is from these seeds that the first trees originated. Since Lobb's excursion the greater part of, if not all, the trees on the ridge have been destroyed by forest fires. It is to be found growing at Castle Kennedy, Wigtonshire.

Abies grandis is a tree of the plains and valleys rather than the

mountains, and attains its grandest proportions in the lowlands of Washington and Oregon. It was discovered by Douglas in his 1830 exploration. He sent seeds to the Horticultural Society of London, but few germinated, and no more seeds were sent for nearly a quarter of a century. In 1851 Mr. Lobb sent seeds to the firm of Veitch, which were planted at their nurseries at Exeter in the following year. And in the same year seeds were received by the Scottish Oregon Association from their collector, John Jeffrey, from which originated the many fine specimens growing in Perthshire. The consignments are at all times small, a circumstance that can be partly accounted for by the difficulty of procuring cones that are produced only near the tops of trees over 200 feet high. The trees in this country, especially the older, cone freely. Fine specimens are to be seen at Castle Menzies, Abercairney, Murthly Castle, and the Cairnies.

Picea Menziesii, a native of the seaboard of Washington and Oregon and the slopes of the Cascades, is confined to a narrow belt extending from Alaska to California, rarely spreading inland more than 50 miles, forming pure forests, or with *Abietia Douglasii*, *Tsuga Albertiana*, and *Thuia gigantea*. It attains its greatest development in the littoral districts of Washington and Oregon; at its northern limits it is reduced to a low shrub.

"No tree in the American forests grows with greater vigour or shows stronger evidences of vitality, and there are few more impressive and beautiful objects in the forests of temperate North America, than one of these mighty spruce trees, with its spirelike head raised high above its broad base of widely-sweeping and gracefully upturned branches resting on the ground, its slender branchlets loaded with cones nodding to the slightest breeze, and its leaves, now silvery white, now dark and lustrous, shimmering in the sunlight."

It grows best in ground constantly wet, even in bogs.

Picea Menziesii first became known to science through Archibald Menzies, who discovered it on the shores of Paget Sound in 1793. It was introduced to Great Britain in 1831 by the Horticultural Society of London through David Douglas, who named it in compliment to the discoverer, and published as *Abies Menziesii* by Lindley in 1833. It had, however, been found by Mertens on the island of Sitka a few years previously, and described as *Pinus sitchensis*. This priority is now generally acknowledged, but the tree is best known as *Picea Menziesii* in British plantations. Veitch mentions fine specimens at Castle Menzies, Murthly Castle, Ochtertyre, and Scone Palace.

Douglas fir—*Abietia Douglasii*.—The Douglas fir does not conform to any of the three classes of conifers. It agrees with Abies in its two

resin ducts. The cones combine characters present in all others, being pendulous as in Picea and Tsuga, but differ from the bracts being longer than the scales, and prominent as in Abies: nearest affinity is Abies, yet so different as to be generally separated by most recent authors.

Abietia Douglasii is the most widely distributed tree of Western America. It is a tree of the mountains, with the exception of the plains and valleys of British Columbia, Washington, and Oregon, where it forms dense forests. It follows the Rockies from Columbia to Mexico; "it must thence possess a constitution that enables it to endure the fierce gales and long winters of the north, and the nearly perpetual sunshine of the Mexican Cordilleras, to thrive in the rain and the fog which sweep almost continuously along the Pacific Coast range, and on the arid mountain slopes of the interior, where for months every year rain never falls."

The Douglas fir is not only one of the most interesting, but one of the most valuable trees of Western America. It attains its greatest development in the humid lowlands of Washington and Oregon, especially round Paget Sound and on the Western slopes of Sierra Nevada. As a proof of the stupendous dimensions attained by this tree, in the Royal Gardens of Kew is erected a flagstaff brought from Vancouver Island, consisting of a single stem 159 feet high.

Abietia Douglasii was originally discovered by Archibald Menzies on the shores of Nootka Sound in 1792, during Vancouver's voyage round the world. At Castle Menzies, not far from the birthplace of Arch. Menzies, are some of the finest specimens in Great Britain. It was rediscovered by Douglas in 1827, and introduced by him in the following year to Britain for the first time. Dr. Lindley selected this tree as the most suitable subject for commemorating the intrepid explorer, and the eminent services rendered by Douglas to British arboriculture.

The Douglas fir is unquestionably one of the most valuable trees ever introduced into Great Britain. It has been planted throughout the length and breadth of the land, and some of the most thriving plantations are to be seen in Perthshire, the native county of Douglas, where the tree has been planted with no unstinted hand, as at Lyndoch and Murthly. Noteworthy specimens are to be seen also at Scone Palace, Caste Menzies, Dunkeld, and Rossie Priory.

Its varieties *glauca*, *macrocarpa*, and *taxifolia* are geographical forms.

Sequoia sempervirens, the redwood tree. Besides their gigantic proportions the sequoias possess a special interest in respect of their antiquity, and the far more important place they occupied in the arborescent vegetation of the earth in past geological ages than at the

present time. They first appear in the lower chalk, and in the Eocene of tertiary times the sequoias were represented in Great Britain by more than one species. During the glacial epoch it is surmised that the genus was well nigh exterminated and was preserved only in the two isolated regions in which it still survives, a narrow strip along the Pacific littoral extending for 500 miles in South California and on the Sierra Nevadas.

Sequoia sempervirens, with its allied congener, *Wellingtonia*, is the most gigantic coniferous tree of the globe. It is one of the most interesting of trees, whether we regard it as a surviving representative of the vegetation of a former epoch which has well nigh disappeared. In Miocene times it was spread over Europe to Spitzbergen. The redwood has disappeared from its vast area, till it has finally receded to the strip of country along the Pacific seaboard of North America.

It was discovered by Archibald Menzies in 1795, and rediscovered by Douglas in 1831.

Sequoia gigantea, the mammoth tree of California. Sequoia is the Latinised form of Sequogae, the chief of the Cherokees. Discovered by Douglas in 1831, though its existence was recorded by Menzies in 1796, but not introduced till 1853 by Lobb, Veitch's collector. Specimens have been found to 400 feet high, but unfortunately the wood is not regarded as durable, being non-resinous and inodorous. Fortunately the tree is hardy enough to withstand the rigours of our winters, and when grown in spacious lands is truly an imposing tree. It is only prized in this country as an ornamental tree, and no collection of choice conifers can be regarded as complete without this species.

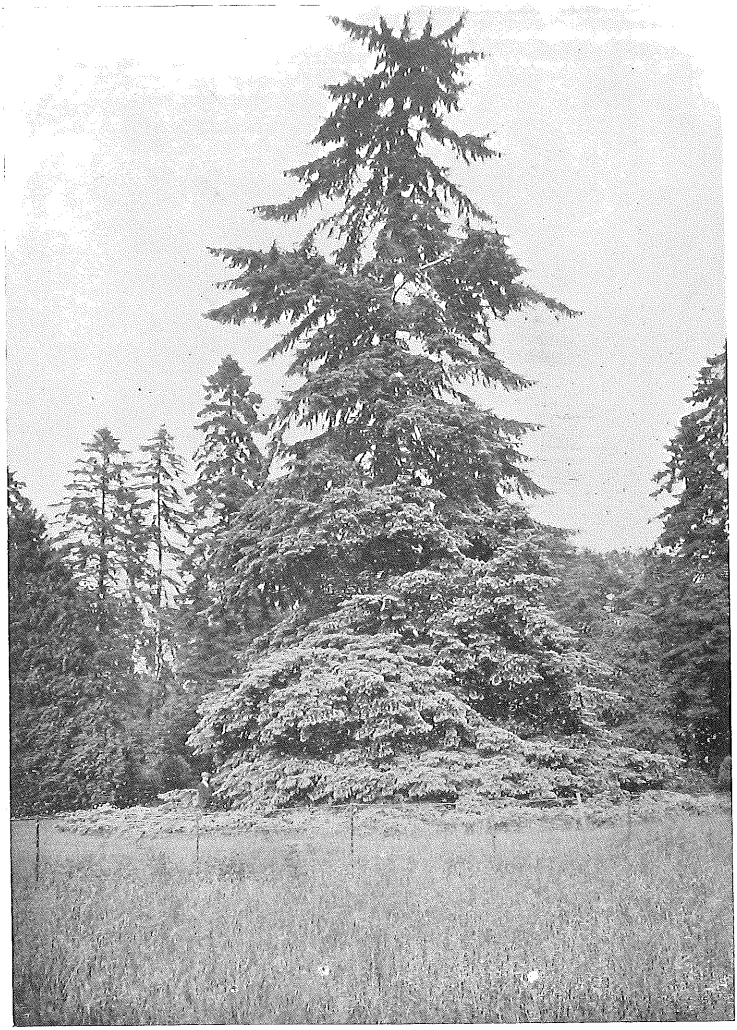
Tsuga Albertiana, one of the Hemlock firs. The origin of the common name has been employed for many years, but its origin is unknown. It is the largest of the Hemlock firs, stretching from Alaska to California. It was discovered by Douglas in 1826, during his first mission to North-west America. He did not send home seeds, confounding it with *Tsuga canadensis*. It was introduced into Britain in 1851 by the Scottish Oregon Association through their collector, John Jeffrey, and named in compliment to the late Prince Consort, patron of the Association.

It is a graceful tree for the lawn or park, forming a pile of foliage, out of which spring a multitude of long whip-like shoots, hanging down like sprays of a weeping willow. Mr. Veitch mentions fine specimens growing at Castle Menzies and Methven Castle. No tree from North-west America has more readily adapted itself to the altered conditions of soil and climate in Great Britain than *Tsuga Albertiana*.

The historical account of Douglas's introduction has been drawn mainly from Veitch's "Coniferae." R. D.

Plate 6.

From a Photograph by Professor Balfour, University of Edinburgh. taken from a Print in the "Companion to the Botanical Journal," in the University Library.



[Photo by A. M. Rodger.

Plate 7.—Abietia Douglasii—The Douglas Fir—Rossie Priory.

Planted in 1833 by Lord George Kinnaird, from Seeds sent by David Douglas to Mr. Turnbull, of Bellwood, Perth.

XII.—*Perthshire Roses.*

(Revised to October, 1910).

By WILLIAM BARCLAY.

In most parts of Perthshire, roses are widely spread and fairly plentiful. They are not nearly so abundant as formerly, since the fashion has come in of clearing off every bush from the edges of our roads, even secondary ones, leaving in most cases the ground free to be occupied by nettles, docks, thistles, and such other decorative plants—special friends, too, of the farmer. Our roses, though they penetrate far into the Highland valleys, are practically absent from the mountain sides, except perhaps a few along the bank of some rivulet, so that difference of altitude does not come in to any great extent to affect our forms. From our more northern situation, however, several species which occur in England—R. micrantha, R. tomentella, R. sepium, R. systyla, and R. arvensis—do not occur with us, at least as native plants, while we are more plentifully supplied with numerous variations of R. mollis, R. glauca, and R. coriifolia. The following table gives the list of Perthshire roses, so far as I have as yet ascertained :—

R. pimpinellifolia *Lin.*
b. spinossissima *Lin.*

HYBRIDS.

R. pimpinellifolia x mollis.
R. pimpinellifolia x tomentosa.
R. pimpinellifolia x rubiginosa.
R. pimpinellifolia x glauca?

R. RUBIGINOSA *Lin.*

R. VILLOSA *Lin.*
(*a.* R. pomifera Herrm).
b. R. mollis *Sm.*

R. TOMENTOSA *Sm.*
a. group R. omissa Déség.

Sepals erect and more or less connivent, crowning the ripe fruit and then disarticulating.

b. gr. R. subglobosa *Sm.*

Sepals spreading or erect spreading, mostly fallen before the fruit is ripe.

c. gr. R. scabriuscula *Sm.*

Sepals reflened, falling early.

EU-CANINAE.

Series I.—Fruit very hard when green, not ripening till October, sepals reflexed and falling mostly before it changes colour. Leaves glabrous on both sides.

R. canina *Lin.*

a gr. lutetiana Lem. Leaves simply serrate and glandular.

b gr. (andegavensis Bast.). Differs from *a* by its hispid peduncles.

c gr. dumalis Bechst. Leaves doubly or compoundedly serrate.

d gr. verticillacantha Merat. Similar to *c* but with hispid peduncles.

e gr. (scabrata Crépin). Similar to *c* but with subfoliar glands few or many.

f gr. (blondæana Rip.). Differs from *e* by having its peduncles hispid.

R. dumetorum Thuill. Similar to R. canina, but having the leaves more or less hairy.

a gr. urbica Lem. Leaves simply serrate.

b (gr. Déséglisei). Peduncles hispid.

c gr. arvatica Baker's Mon. Leaves doubly or compoundedly serrate.

Series II.—Fruit softer when green, ripening early in September, sepals more or less erect, not falling till the fruit is nearly or fully ripe.

R. glauca Vill. Leaves glabrous.

a gr. Reuteri Godet. Leaves simply serrate. Peduncles smooth.

b gr. transiens Kern. Peduncles hispid.

c gr. subcristata Baker. Leaves doubly or compoundedly serrate.

d gr. Peduncles hispid.

e gr. Leaves with subfoliar glands. Peduncles smooth.

f gr. Leaves with subfoliar glands. Peduncles hispid.

R. coriifolia Fr. Leaves more or less hairy.

a gr. incana Kit. Leaves simply serrate. Peduncles smooth.

b gr. bovernieriana Lagg. and Pug. Leaves simply serrate. Peduncles hispid.

c gr. Watsoni Baker. Leaves doubly or compoundedly serrate. Peduncles smooth.

d gr. caesia Sm. Similar leaves. Peduncles hispid.

e gr. Lintoni Schentz. Differs from *c* by having subfoliar glands, few or many.

f gr. Bakeri Baker's Mon. Differs from *e* by having hispid peduncles.

Series III.—This differs from the last series chiefly by having the sepals for the most part reflexed, though some may be spreading and even a few become erect. It has not been fully worked out, but no doubt comprises groups of variations parallel to those in Series I. and II.

R. canina Chr. Leaves glabrous.

R. subcollina Chr. Leaves more or less hairy.

R. arvensis Huds., R. alpina Lin., and R. lucida, Ehr., have been found more or less naturalised, but are, of course, not indigenous in the county.

Species enclosed in brackets do not occur in Perthshire.

R. PIMPINELLIFOLIA, LIN.

The Scottish or Burnet rose is pretty widely distributed throughout the county, but cannot be said to be anywhere abundant, except perhaps at some stations on the banks of the Tay. It occurs also on the tops of some of the hills near Dunkeld, sometimes in a very stunted form. The var. spinossissima, Lin. distinguished from the type by having the peduncles and sometimes the fruits more or less glandular, occurs occasionally, but I have not seen in Perthshire any of the other named varieties which are found on the Continent. This species seems to hybridise easily with other species when growing in colony along with them.

HYBRIDS.

R. pimpinellifolia x tomentosa (R. involuta Sm.).—This is the commonest of our Perthshire hybrids. I have gathered it at six separate stations, viz., Glenfarg, Callerfountain, Waulkmill, Gleneagles, Auchterarder, Loch Cluny. It is also recorded from Dunkeld (Borrer).

Most of our forms stand more or less midway between the parent species. The Auchterarder plant is nearer tomentosa, though the influence of pimpinellifolia is also quite apparent. Almost certainly in the case of this last hybrid, and probably in the case of some of the others, the second parent is a form of what I have called gr. R. omissa Déség. At none of the stations except at Waulkmill do we find more than one or two bushes.

R. pimpinellifolia x mollis.—So far I have found this hybrid in Perthshire at only one station, near Kinfauns. Crépin, after seeing numerous specimens, agreed with my determination, and I may add that further experience has served to strengthen the opinion which I formed regarding it. It grows amongst the two parent species.

R. pimpinellifolia x rubiginosa.—A fine clump of this rare hybrid was found by me growing on the left bank of the Tay below Caputh Bridge. Both the parent species are plentiful at this spot, and there can be no question that the hybrid has been naturally formed in this station, and that it is not, as in Aberdeenshire, an escape from cultivation. It has white flowers, and differs from R. biturigensis Bor., by having the peduncles and fruits glandular hispid instead of smooth.

R. pimpinellifolia x glauca (R. hibernica Sm.).—This occurred on two stations on opposite banks of the Tay near Dunkeld, but has since been extirpated. Both bushes appeared to be nearly identical. I believe them to have had a form of glanca rather than of canina for the second parent.

R. RUBIGINOSA, LIN.

The sweet-briar is pretty widely spread throughout the country, especially in the lowland parts. I have not paid very much attention to its variations, but the majority of our plants would be classed under the variety comosa Rip. A bush with flowers, white or almost white, occurs below Caputh Bridge, which Crépin said should be grouped along with, or in the neighbourhood of, R. Gremlii Chr., and R. rubiginosa Lin., var. Moutini Crép. Of course he did not mean that it was identical with either of these.

R. MOLLIS, SM.

This species is widely spread and abundant in all the districts of Perthshire, more especially, perhaps, in the Highland valleys. It is a beautiful rose both in flower and fruit, easily distinguishable at a glance when growing. It flowers somewhat earlier than our other wild roses, with the exception of R. pimpinellifolia, and its large bright red fruits are conspicuous in the last weeks of August, being ripe about a month earlier than those of R. tomentosa. Although usually a bush of rather low stature and of very compact growth, it is often found, in good soil and where it has not been disturbed by pruning, of much taller and somewhat looser growth, attaining a height of 6 to 8 feet. It shows considerable variation as regards size and even shape of leaflets, their degree of hairiness and of glandular development; size, shape, and clothing of the fruits, length and clothing of peduncles, and so on.

But I have not as yet been able to divide the species into satisfactory varieties, nor do I think that the hitherto described varieties are of much account. No doubt you can find forms which answer more or less closely to var. caerulea Baker, and to R. subrubiginosa Lejeune (Arduennensis Crép.), but the characters on which the first of these is founded are too variable even in the same plants to serve as good distinctive marks for a variety, and the second, apart from its strong glandular development, has no special characters which can be relied on. It is simply one of the very numerous glandular forms of the species, and, in my opinion, does not deserve to be singled out and endowed with a special name.

Crépin maintained, and I thoroughly agree with him on this point, that R. pomifera Herrm, and R. mollis Sm. are not specifically distinct, and that they should be united under the old name of R. villosa Lin. This united species should then be studied afresh and divided, if possible, into natural groups, each of which should receive a varietal name. The typical R. pomifera Herrm., should include the so-called variety recondita Pug., as if there is any difference between them it is only that the latter is somewhat more glandular on the under side of the leaflets. I do not think that any of our Perthshire, or indeed any of our British forms, are identical with the pomifera forms of the Continent, though, as I have already said, the points of difference are not such as are sufficient to separate them specifically.

R. TOMENTOSA SM.

This species, under numerous forms, is widely spread in Perthshire, but it is quite out of my power to divide it into any of the named varieties or so-called species. It seems to me, however, to fall into the three groups which I call *a.* R. omissa Déség., *b.* R. subglobosa Sm., and *c.* R. scabriuscula Sm.

a. gr. R. omissa Déség.—R. omissa Déség, as I understand it, is a mountain form of the aggregate R. tomentosa Sm., found chiefly upon the dry calcareous heights of the Jura, and no doubt taking on a certain facies from the locality, which we can hardly expect to find exactly reproduced in Scotland. But we may expect, and I think we find, a boreal form, having at least some of the chief characters of the omissa. Crépin says (*Excursions Rhod, dans les Alpes*, 1890, page 169): "There exist divers variations of R. tomentosa, with sepals erect, which cannot be joined to the R. omissa. How should these be considered? That is what the future will teach us, after that a revision very thorough has been made of R. tomentosa. Before such a revision has been made, it is not possible to give a description of R. omissa which will permit this to be always distinguished with certainty from allied

forms with sepals erect. For the present I limit myself to say that its foliage has often a tint lightly blueish, recalling that of the villosæ, that its leaflets are less acute, with the secondary veins more prominent, that its peduncles are usually short, its corolla of a lively rose, its sepals very long persistent, and disarticulating only when the fruit is completely ripe." Now, in those of our Perthshire forms which I consider should be grouped along with R. omissa, the petals are deep red, almost as in R. mollis, the peduncles may be short or long, the sepals are thoroughly erect and even more or less connivent, and they persist, or at least the greater number of them, till the fruit is fully ripe, and indeed not a few on each bush do not appear to disarticulate at all. The leaflets are always glaucous, and at least on the under side have often a bluish tint. It is true that we have in plenty what seem to be unknown in the Continental R. omissa, and indeed to be very rare in the tomentosa of the Continent, forms with white flowers, only tinged a little with red on the outside of one or two petals, but in other respects agreeing with the red-flowered forms. So far as I can see at present, I think our forms should be put into the same group with R. omissa.

b. R. subglobosa Sm.—forms in which the sepals are spreading or erect spreading, and in which the sepals do not persist, at least in any number, till the ripening of the fruit, but fall during its coloration. This, being an intermediate group between *a* and *c*, is sometimes not very easily distinguished from either; in fact, I believe no definite limit can be fixed on either side, though many of the forms are easily enough determined. It appears to be less common with us than gr. *a*.

c. R. scabriuscula Sm.—This group, which includes several named varieties, as scabriuscula Sm., sylvestris Lindl., cuspitatoïdes Crep., is very common in England, especially in the south, but is certainly very scarce in Perthshire, and I have seen very few well-marked examples of it in the county.

Eu-canineae.

In this very large group I have followed, in the main, the classification of Crépin, as given in the *Tableau Analytique des roses Européennes*, a classification which at bottom is not very different from that of Baker or of Christ. I look upon the whole as really forming one polymorphous species, but dividing naturally into the various sub-species, or if you like species of a secondary order. The varieties given under each sub-species are, however, more or less artificial. They are, however, useful for classifying the very large number of variations which each sub-species includes. Possibly we

may by and by arrive at a better classification founded upon natural affinities, but we are still far from reaching that goal. No doubt numerous so-called species or varieties have been described under each head, but generally they have been founded upon the individual characters of one or a very few bushes; and the specimens distributed by their authors, or accepted by them, agree neither with each other nor with the original diagnosis. The perfect inanity of most of these so-called species is well shown in the able and laborious account of the specimens contained in the herbarium of Déséglise by Major Wolley-Dod, though the writer does not seem to have deduced the true conclusion which follows from his researches, a conclusion which such men as Baker, Christ, and Crépin long ago reached.

R. canina Lin.—This sub-species is not uncommon, especially in the lowland parts of the county, but its variations are few with us compared to what they are in the middle and South of England. Our forms seem confined almost entirely to groups *a* and *c*, with intermediates, and though I have seen forms belonging to *d* they were at all not well characterised.

R. dumetorum Thuill.—The distribution of this is much the same as that of R. canina. Most of our forms, from the scantiness of hair on the leaves, would come under what is called var. urbica, Lem. The styles are, generally speaking, hairier than in the last group. The arvatica of Baker's Monograph is clearly defined by the author when he says, "Bears much the same relation to urbica that dumalis does to lutetiana." No doubt he seems, under this name, to have distributed specimens belonging to tomentella and coriifolia, as well as those belonging to dumetorum, but his definition clearly implies a form differing from typical dumetorum only by having more or less compound leaf-teeth, and in that sense I think the name should be used, if it is to be retained at all. This group is not common in Perthshire, and indeed I have only seen a few examples anything like well-marked, and none have the serration "copiously compound," as in Baker's description of his variety.

R. glauca Vill.—This sub-species, a mountain or boreal derivative from R. canina, is widely spread and abundant in Perthshire. It comprehends a very great number of variations, including many forms under each of the six groups. Groups *e* and *f*, however, are but feebly characterised, the sub-foliar glands never being numerous, and seldom present on all the leaflets of the same plant. In fact, it often requires the microscope to make sure of their existence. I have not given names to groups *d*, *e*, and *f*, because I do not know what names have the priority, and have not access to books or herbaria which would decide the matter.

R. coriifola Fr.—This bears the same relation to R. glauca that R. dumetorum does to R. canina, that is, it differs in having the leaves, at least on their under surface, more or less hairy. The hairs are sometimes confined to the midrib and are sometimes so few as to show how slight is the division between the two sub-species. R. coriifolia, Fr., is equally abundant with R. glauca, and perhaps comprises even a greater number of variations.

R. caesia Sm. was certainly a form belonging to group *d*, and being the oldest name, I have taken that as the name of the group. Var. Watsoni, Baker, was also made to include forms belonging to group *d*, and hence I have preserved the name, but restricted it to *c*. Var. pruinosa, Baker, belonged to the same group. Contrary to what occurs in the parallel groups in R. glauca, groups *e* and *f*, in R. coriifolia are wide spread, often strongly characterised, and fairly abundant. The sub-foliar glands, it is true, are often few and difficult to see, but in other cases they are numerous and easily distinguished. In *f* the peduncles have sometimes not more than two or three acicles, but in other cases they are pretty thickly hispid. There can be no doubt that var. Bakeri comprised forms belonging both to *e* and *f*, but Scheutz separated his var. Lintoni, which certainly belonged to *e*, and therefore I have restricted var. Bakeri to *f*. This maintains the parallelism with the other sub-species, and besides I do not think that Lintoni and Bakeri can be separated by the shape of the fruit as Major Wolley-Dod tries to do. It is not at all rare to find fruits sub-globose and others more or less turbinate on the same bush, and in some of our forms the fruit is long and pyriform. I have not met with forms in which the fruit could be described as ovoid. The leaflets often take the obovate shape described by Mr. Baker, but are as variable in this respect as in the other groups. Sometimes they resemble in shape the leaflets of tomentella, and hence immature specimens have been named var. tomentella Lin., and var. decipiens Dumor. by those who did not know well Lintoni and Bakeri. It is to be noted that we have in Perthshire forms which are much more glandular on the under side of the leaflets than what is implied in Baker's description.

R. sub-canina, Chr., and R. collina, Chr.—These comprise forms which, while bearing a strong resemblance to R. glauca and R. coriifolia, have yet some of the characters of R. canina and R. dumetorum, and especially that their sepals are reflexed, or at least do no not rise above the disk, except perhaps a very few. The sepals also do not persist quite so long as in R. glauca and R. coriifolia, beginning to fall off while the fruit is colouring, and though

some may persist till the fruit is ripe, a touch at that stage will cause them to fall. These sub-specie have not been well worked out as yet. It is probable that they comprise groups parallel to those of the other sub species, but I have not yet been able to separate very many of them in Perthshire. In R. sub-canina I have seen forms belonging to groups *a* and *c*. The group of variations which I described in the Annals of *Scot. Nat. His.* for 1899, p. 172, under the name of sub-coriifolia, comes under R. collina Chr., and comprises forms belonging to gr. *c*, *e*, and *f*, most of them to *e*. Borrer's R. caesia Sm., var. incana, no doubt belonged to *c*, and to this extent might be considered as similar to, though not identical, with my sub-coriifolia.

[This part, pp. 35-74, published 10th November, 1910.]

XIII.—*Some Discomycetes of the Locality and their Habitats.*

By J. MENZIES.

(Read 10th November, 1910.)

Although the purpose of this paper is to give an account of some of the Discomycetes found in the neighbourhood of Perth, a few words describing, in a brief manner, the chief characteristics of these Fungi may not be out of place.

Though not usually so conspicuous as the mushroom, or Hymenomycetes fungi, the Discomycetes are neither few in number nor uninteresting. More than six hundred species have been found in Britain, and the number is being added to from time to time by fresh discoveries.

The majority of Discomycetes belong to the genus Peziza. The typical form of a Peziza is that of a cup, from which they are popularly known as the cup fungi. In many species this cup-like form is only retained for a short time, and as they approach maturity become flattened, plain, or even convex. In size they vary from six inches across to tiny forms not half a millimetre, and amongst the more minute are many of great beauty. The cup may be supported by a well-defined stem, or only contracted into a stem-like base, while many are altogether sessile.

In colour they vary greatly—red, orange, yellow, brown, or dull purple, and not a few are white or hyaline. Many are adorned on the outside of the cup with hairs, which are usually longest and most conspicuous at the margin.

However much these fungi may vary in size, colour, or details of structure, in one feature they are all alike, that is in having the spores or reproductive bodies produced in mother cells, the asci, each ascus usually giving birth to eight spores. A fine variety of form is presented by the spores of the different species: spherical, elliptical, clavate or needle-shaped. All are at first smooth and colourless, and many remain so. Others at maturity are covered with warts, spines, or net-like ridges. Some become brown or change from hyaline to violet, finally becoming brown. As the spore characters of the different species are fairly constant, these are of prime importance in their identification.

The object of this paper is to tell you where, and under what circumstances, these cup fungi are found in our locality, and as I shall mention very few which have already been recorded for the

County, it may be regarded as a contribution to our knowledge of the Discomycetes occurring in Perthshire.

Two circumstances have enabled me during the past autumn to add considerably to this list. The first will be fresh in your recollection, the abnormal rainfall in August. The other is, that during the last seven or eight years a great deal of wood-cutting has taken place on the estates of Kinfauns, Murrayshall, Scone, and at the Muirward of Scone. After the branches lopped from the trees have become dry, these have been gathered into heaps and burned, leaving masses of char on the ground. These charcoal heaps are much affected by many species of Peziza.

Within the municipal boundaries, in the lane going off the Gannochy Road towards Corsiehill, we find two species associated with the nettle. In early summer *Erinella Nylanderi*, Rehm., grows on the last year's dead stems. This is a small fungus densely clad with yellow hairs. In September *Lachnea Dalmeniensis*, Phil., is found on the damp soil beneath the growing plants. This Peziza was first discovered at Dalmeny, hence the name, and it may interest you to hear that it is pale yellow or primrose in colour.

On that rather conspicuous heap of farm rubbish on the Corsiehill Road, *Humaria domestica*, Mass., occurred in July on the remains of burnt cabbage stalks. A small fiery red species, densely gregarious, it is sometimes found on damp papered or plastered walls, and from this circumstance receives its name.

At Corsiehill during the past autumn *Neottiella polytrichi*, Mass., occurred in abundance on ground which had been turfed some years ago. As its specific names indicates, this plant is usually found growing with the polytrichum moss. Dr. Buchanan White, in his Preliminary List of the Fungi of Perthshire, recorded this species from Rannoch. There also he found a form of this, with a longer stem than that of the type, and then known as *Peziza vivida*, Nyl., but which is now usually regarded as a variety of *N. polytrichi*.

On Kinnoull Hill in January last we collected a good deal of *Humaria hepatica*, Sacc., a small liver-coloured fungus, which seems to be always associated with rabbits. Specimens found after 29 degrees of frost had been registered were apparently little the worse. In winter also *Helotium subtile*, Fries., occurs on the leaves of pine branches lying on the ground, and *Dasyseypha stereicola*, Mass., on dead blackened *Stereum hirsutum*. In June last we discovered *Humaria Roumegueri*, Sacc., growing on much-decayed vegetation, and loosely covered with moss. This is a small yellowish gregarious species, very rarely found in this country. In summer we find *Dasyseypha leuconica*, Mass., on dead heather stems, and *Belonidium filisporum*, Phil., on the dead stems and leaves of the false brome

grass, *Brachypodium sylvaticum*. On damp clay soil in September *Peziza succosa*, Berk., occurs. This Peziza is rather remarkable for possessing a yellow juice, which flows out when the plant is injured, the circumstance often enabling one to recognise it at a glance, as when pierced by an insect a drop of this yellow liquid oozes out and hardens at the orifice. On the remains of a small fire on the hill we gathered, in September, two specimens of *Curreyella trachycarpa*, Mass., a dark purplish fungus with globose, densely warted spores, brown in colour, almost opaque.

Coming down to the old quarry at Muirhall, here we have at different times collected *Belonidium vexatum*, de Notaris; *Helotium flexuosum*, Mass.; *Dasyseypha palcarum*, Mass.; and *Dasyseypha albo testacea*, Mass., from the dead stems and leaves of cocksfoot grass. Here, too, we find *Dasyseypha dumorum*, Mass., on dead leaves of the bramble. On one occasion in August of last year we discovered *Lachnea ascoboloides*, Mass., occupying the ground where manure of some kind had lain. Hoping to gather it again this season we visited the spot, but found some wanderer had lodged there and kindled a fire on the very place our fungus grew. The quarry also yielded a few cups of *Barlaea Crouani*, Mass., all we have met with in the locality.

Keeping up hill and turning to the left by the Deuchney quarry, on that dry bank at the entrance of the quarry we have several times collected *Barlaea cinnabarina*, Sacc., a minute red species with finely-netted spores. On the damp soil of the quarry *Sphærospora trechispora*, Sacc., appears every autumn. Although fairly common in the neighbourhood, this plant attains here a size and brilliancy of colouring which we meet with nowhere else. Beyond the quarry, on the right, an immense heap of sawdust marks the spot occupied by a sawmill for some time. On the old char from the furnace *Lachnea cretea*, Phil., occurred very freely last year. This season it hardly appeared, but in its room we gathered *Peziza leiocarpa*, Curr., a plant somewhat resembling *Curreyella trachycarpa* found on Kinnoull, but quite distinct in its smooth colourless spores. On comparatively fresh heaps of charcoal by the wayside, after those August rains, *Humaria carbonigena*, Sacc., appeared, covering the char with a dense growth of yellow cups, but varying so much in size and shade that we could hardly believe them to be all one species until examined with the microscope. Growing with these was a small purple fungus, which proved to be *Humaria exidiformis*, Sacc., a somewhat uncommon species. At this part of Kinfauns two years ago we found *Desmazierella acicola*, Libert., a small Discomycete densely clad with black hairs, which in this case are not confined to the outside of the cup, but extends to the disc as

well. This was gathered from the leaves of cut pine branches lying on the ground, and from the same branches we had *Dasyseypha acuum*, Sacc., a minute white species occurring in countless numbers, and which we believe has no special season of growth, as we have met with it since at all times. Here, too, we found *Mollisia aquosa*, Phil., on branches of a fallen goat willow, and from inside the bark of the same tree, *Orbilia rubella*, Karst. In June *Dasyseypha rhytismatis*, Sacc., is in evidence, a minute white species, densely gregarious, occupying those black blotches on leaves of the acer caused by another fungus, *Rhytisma acerinum*. Keeping over the hill, we come to another of those sawdust heaps. On the margin of this, on rather wet soil, *Barlaea modesta*, Sacc., flourished for quite a month during the past autumn. This species was added to the British Fungus Flora by the Yorkshire Mycologists a few years ago. The globose spiny spores of this plant are very beautiful microscopic objects. Near this, in August, *Humaria humosa*, Sacc., appeared (no new record for the county, however), and which I would hardly have mentioned but for the fine appearance it made, decking the margins of the moorland footpath for many yards with hundreds of its blood-red cups. At this particular part of my locality *Mitrula cucullata*, Fries, occurs on pine leaves, not, however, directly under the pine trees, but on leaves carried by the wind and falling under deciduous trees, the fungus here finding the necessary protection of rotten leaves and other herbage.

Turning north-west, we arrive at those hill pastures overlooking the farm of Parkfield. At this place we discovered that *Selerotinia curreyana*, Karst., is abundant in May and June. The fungus arises from a small black selerotium, or resting bulb, produced in the pith of rushes the previous summer. It is found about the base of rush clumps *(Juncus effusus)*, arising from bits of discoloured leaf which enclose the selerotium, each bulb producing from one to a dozen cups. This plant was recorded by Dr. B. White from Methven Bog. Last summer on the pasture ground we found *Sepultaria semiimmersa*, Mass., on some very old cow dung, appearing at first as a series of black balls cracking the matrix; the balls then slowly opened, disclosing the flesh-coloured disc. In September we find *Lachnea Caprinaria*, Phil., on cow dung. This species was first discovered at Rannoch by Dr. M. C. Cook and Dr. B. White, on the occasion of the great Fungus Show in Perth in 1875. In spring *Ascophanus granuliformis*, Bond., occurs on cow dung, and *Ascobolus vinosus*, Berk., on rabbit dung.

Keeping along the hill top we approach the Lynedoch Monument. Some years ago my attention was drawn to a fungus growing here by our member, Mr. William White. This proved to be *Peziza ancilus*,

Pers., and since then we have met with it a good many times about old pine stumps and on soil mixed with sawdust. This is the largest of the *Pezizae* with which I am acquainted, and when old becomes spread out on the ground in a curious manner, giving one the idea of extreme decrepitude. It appears in spring sometimes as early as March. On the hillside below the monument *Neottiella leucoloma*, Mass., appeared in myriads during the past autumn, interspersed in some places with *Neottiella polytrichi*, already mentioned. Superficially the two species resemble each other, both being orange red in colour, and also sharing the partiality for the presence of polytrichum moss. The circumstances under which these fungi appeared in such profusion are these: the hill was, until a few years ago, densely wooded with conifers; these were cut down and the branches burned. The old pine leaves gradually disappeared, grass sprang up over the hill, but immediately around the old stumps and where the branches were burned is only a thin covering of polytrichum and other mosses, and on these spots the fungi appeared. Coming down by Bonhard we may note in passing that in August *Geopyxis cupularis*, Sacc., may usually be found growing in the ditch under the old lime trees. In this ditch we collected from dead wood *Orbilia luteo-rubella*. Near the entrance to the den, going towards Scone, *Helotium laburni*, B. & Br., occurs on the dead branches of the laburnum, splitting the bark and appearing in long lines through the cracks. On the great clay heaps at Scone quarries *Humaria violacea*, Sacc., occurs very freely. Although specimens may be met with in small quantities in other parts of the locality, the plant seems to have a kind of head-quarters here, and in moist weather during August and September the violet cups can readily be found nestling under the sheltering leaves of the coltsfoot. At this spot we have collected *Belonidium Arctii*, Mass., a small species affecting dead stems of the burdoch, *Arctium lappa*.

And now I shall ask you to go farther afield with me to the Den of Balgarvie, better known locally, perhaps, as Cox's Den. This place is situated about one-and-a-half miles from New Scone, the entrance turning off the Coupar Angus road a little way beyond the farm of New Mains. The den itself is a deep ravine, the banks in many places almost precipitous, and through which the Annaty Burn flows. At one time heavily wooded, the trees were nearly all cut down about a dozen years ago, and, although replanted, it is covered with a dense growth of the coarser herbaceous plants. In this place we collected two species new to science. *Helotium tetracosporum*, Rea, as its name indicates, has only four spores in the ascus. It is a small dingy yellow fungus affecting the dead stems of the tall canary grass. The other is a small bright yellow species, beset with

awl-like hairs at the margin, from which circumstance it has received the name *Dasyseypha camplytricha*, A. L. Sm. This was found on dead stems of the field thistle. Both were described in the Transactions of the British Mycological Society. In this place we have found *Echinella senecionis*, Mass., on dead stems of the cow parsnip, affecting such parts of the cuticle as may have survived the winter. From the same host we gather *Dasyseypha leucophea*, Mass., and *Dasyseypha asterostoma*, Mass., the latter being one of the most minute and beautiful of this family, having the margin prettily fringed with crooked hairs all turned in one direction. On dead stems of the tall canary grass we find *Belonidium pulum*, Phil. and Keith., and *Dasyseypha prasina*, Mass., while *Dasyseypha scintillans*, Mass., is abundant on dead leaves of the oak.

From the Den it is but a short distance to the Muirward of Scone. Here a large area of ground has been cleared of wood within recent years. From comparatively fresh heaps of char we gathered in October last *Peziza pustulata*, Pers., and *Peziza sterigmatizans*, Phil., two rather large-growing plants. Here also we found giant specimens of *Peziza leiocarpa*, Curr., and another two ascophores of *Curreyella trichycarpa*, Mass., and for the first time in the locality we met with that curious Discomycete, *Rhizina inflata*, Quelet, a species forming shapeless crust-like masses on the burnt ground. Some years ago, in visiting this place, we discovered a few cups of *Humaria purpurascens*, Sacc., and found that *Echinella setulosa*, Mass. and Crossl., was not uncommon on dead stems of the heather.

Coming down towards New Scone we arrive at what is known as the back road or sandy road. On the side of a ditch there we discovered a small white species, furnished with long bristle-like outgrowths at the margin of the cup. A well-marked fungus, we could find nothing in our Fungus Floras to agree with it, and specimens were submitted to Mr. Carleton Rea, who refers it to *Cyathicula alba*, Pat., a species not hitherto found in this country. Along the side of the high road between Old and New Scone the wood was cut down some years ago. On the char heaps we found, in September, masses of *Sphaerospora brunnea*, Mass., and on the moss-covered buttresses of an old stump *Barlaea Wrightii*, Sacc., both uncommon species.

Now we arrive at Quarrymill, a place, we venture to say, which would be hard to beat as a hunting ground for *Pezizae*. In the old dam, where, since the shutting-out of the water, docks and nettles, comfrey, thistles, umbellifers and meadow sweet have striven for the mastery, we find *Belonidium deparculum*, Mass., and *Dasyseypha nidulus*, Mass., both on dead stems of the meadow sweet. I was greatly indebted to some gentleman who left his trousers here in the early spring of last year. Now I know nothing as to the gentleman's

reasons for this desertion of his nether integuments. We have no doubt that to the gifted author of *Sartor Resartus* the incident would have been fraught with deep meaning. He might, perhaps, have seen in this a great act of renunciation in deference to the demands of the militant suffragettes! Be this as it may, the trousers (a very ordinary pair of velveteens, by the way) when first met with were covered with tiny red specks, which proved to be *Gymnoascus ruber*, Van Tiegh, a species in which there is no enclosing cup, the asci being borne directly by the mycelium, and which, perhaps, hardly comes within the scope of this paper. This was followed two months later by *Peziza lintecola*, Phil. and Plow., a fungus affecting cotton and linen material lying in damp places, and which we have found since on jute sacking left about the borders of fields or under hedges. In the autumn *Ascophanus carneus*, Bond., appeared in immense numbers, followed later by *Orbilia vinosa*, Karsten. The latter kept possesion of the trousers a long time, and when it had finally disappeared the remains could have been packed in very small compass. On the clay banks at the falls *Barlaea Persoonii*, Sacc., is found, and during the past July was particularly abundant. Higher up the bank, under the shade of the trees, *Sepultaria arenicola*, Mass., occurs. Although not altogether a scarce fungus here, it is difficult to secure good specimens, as in many instances the disc is hardly level with the ground, and in this condition in moist weather it becomes rapidly covered with a mould. In the quarry *Ascobolus denudatus*, Fries, appears in Autumn on a clay bank over which water trickles during the winter months and which is never quite dry. From a few yards of sandy soil on the bank of the burn we have collected these past two seasons *Humaria Phillipsii*, Cke., a small blackish-purple species, extremely rare. In various parts of the den we have met with *Lachnea Woolhopeia*, Phil., growing on damp ground and burnt soil, a small species furnished with dense clusters of brown hairs. The fungus was first found at a meeting of the Woolhope Field Club, and named in honour of that society. On the dumping ground at the entrance to Quarrymill we first discovered *Lachnea umbrorum*, Gillet, but have since found it is not rare in the locality. On the right bank of the stream, close to the Old Scone Road, comfrey was cultivated for a long time, but some years ago an effort was made to root it out, and the ground was planted with conifers. The comfrey still comes up the same and is cut down in early summer, the stems being allowed to lie on the ground. In a short time these dead stems become infested with numerous woolly balls, which gradually harden from the centre outwards, becoming at the same time dark in colour, and round, oblong, or irregular in shape. Freed by the decay of the comfrey, they lie on

the ground all winter, and the following May germinate and produce the long stemmed cups of *Scleorotinia sclerotiorum*, Mass. Usually described as a parasitic fungus, it can hardly be said to be that in this instance; and I have failed to find that the fungus affects in any way the numerous plants of comfrey naturalised in other parts of the den, which are not cut down.

Occurring on wood here we find in winter *Karschia lignyota*, Sacc., appearing on oak sticks which have been blackened by other fungi, and the drab-coloured cups of *Dasyseypha canescens*, Mass., which seems indifferent as to the kind of wood it affects. *Helotium ochraceum*, Berk., we have found on hawthorn and willow twigs, while *Belonidium ventosum*, Phil., has wandered the whole of the past summer over an old alder stump. On fallen decayed female catkins of the alder *Ciboria amentaea*, Fckl., is fairly abundant some seasons.

On the shady part of the Old Scone Road, a little beyond Quarrymill, we gathered in September last specimens of *Humaria Chateri*, Sacc., a fine bright red plant with finely-netted spores; and *Lachnea umbrata*, Phil., a much less attractive species. Both occurred on road scrapings. The last part of my locality is the Tay bank to Kinfauns. Here we have met with *Humaria omphalodes*, Mass., on char; *Helotium allniellum*, Karst., on fallen catkins of the alder; *Helotium phyllogenon*, Rhem., on dead leaves of the poplar; and *Helotium albidum*, Pat., on dead leaf-stalks of the ash. In the back-water of the Tay at Kinfauns we secured specimens of *Belonidium excelsius*, Phil., growing on dead stems of *Arundo Phragmites*. At first sight the back-water, with its accumulation of rotten reeds and sticks, would seem an ideal spot for the fungus collector. It is, however, disappointing, as the ebbing tide leaves on every thing a deposit of fine silt from the muddy bottom which is not favourable to fungoid growth.

Two species of Discomycetes I may mention are of general occurrence in the locality, viz., *Ascobolus viridis*, Currey, found on damp soil, usually solitary or not more than two or three together; and *Ascobolus atrofuscus*, Phil. and Plow., occurs about the margins of old fires in the lanes and out-of-the-way places.

We have three species of aquatic or semi-aquatic Discomycetes here: —*Vibrissea Guernisaci*, Crouan., on wood lying in ditches or very damp places; *Humaria lechithina*, Sacc., is confined, so far as we have seen, to the Annaty Burn, where it is found on wet sodden wood; *Humaria Oocardi*, Sacc., occurs in all the smaller streams about Perth, growing on wood, sacking, or almost anything. The finest specimens we have met with were growing on a leather strap or tawse, which used to be considered a necessity in encouraging the young idea how to shoot!

In conclusion, let me say that the identification of these fungi is not always an easy matter; and when one is unable to identify some particular find, or when confidence in one's own conclusions is not quite assured, it is always a pleasure to be able to submit both to friendly help or criticism. In this connection I desire to offer my thanks to Mr. Carleton Rea, B.C.L., B.A., the Honorary Secretary of the British Mycological Society, whose wide knowledge of the Fungi and of the literature pertaining to the subject he has always been pleased to place at my service, and of whose courtesy at all times I cannot speak too highly; also to my friend, Mr. Charles M'Intosh, of Inver, with whom I have shared an interest in the Cryptogamia for a good many years.

XIV.—*The Modern Aspects of Eugenics.*

By James P. Sturrock, M.A., M.D., Medical Officer H.M. Prison, and Medical Superintendent, Criminal Lunatic Department, Perth.

(Read 9th February, 1911.)

A sound health and sound morality are the foundations of a nation's progress, and how best to promote these must be the concern of every patriot. The subject of eugenics or good breeding is not of recent origin, though it is in accordance with the spirit of our time that it should be raised to the level of a science as a result of our advances in a knowledge of biology, and our investigations into the nature and causation of disease. It is an interesting fact that Darwin's *Origin of Species* and Morel's *Treatise on Degeneration* were produced almost coincidently, and probably the latter work more than the former is reflected in the present-day attitude to the question of racial fitness. It were well for us to remember, in view of the rapidly increasing interest in eugenics, already the subject of the most widely divergent opinions, that we live in an age of sensationalism, and at the same time of much indifference, and it were greatly to be deplored should these attitudes lead us, through hasty generalisation and too readily accepted data, to the inevitable "nine days' wonder."

No one of the races and civilisations whose decline and fall are historically familiar to us, no one of the unrecorded civilisations

which in the countless ages of human existence have peopled the earth, but has had its prophets of doom, its apostles of racial salvation. Though popular opinion is ever ready to make sweeping deductions from the outstanding facts of history, nothing is more certain than that we have no true record of the extent to which the decay of former civilisations was due, either to the presence of similar weakening tendencies to those that exist amongst ourselves to-day, or to the untimely neglect of those who foresaw the consequences. Yet are we being constantly likened to the ancient Greeks. Some thinkers assert that nations grow and decay inevitably like the individual, others that civilisation, by transmitting its accompanying luxury and inertia, tends to degeneration in the purely national form of inability to lead the van amongst the empires of the world. To accord with the scientific spirit of the age, we are now told that the interference of civilisation with the process of natural selection is the real genesis of decay. Those who pride themselves upon historical comparisons will find some difficulty in reconciling the latest theory with this statement by Mahaffy.* "The enlightened Greeks stood nearer, I fear, to the savages of the present day, who regard without respect or affection every human being who has become useless in the race of life, or who even impedes the course of human affairs." These enlightened Greeks, too, are estimated to have been intellectually as far ahead of us as we are of the South African negro. The truth is, we must, if we are to solve this matter on biological principles, clearly distinguish between civilisation and human progress. No civilisation, such as we know at anyrate, can become fatally luxurious and idle without the compensatory accumulation of the miserable and overworked; poverty and degeneration are often confounded, and whilst intellectual and physical perfection is the most desirable basis of a civilisation, the terms to-day are not synonymous.

No one will take exception to the eugenic principle that to secure a nation's progress, every means must be taken to increase the fit and decrease the unfit. If we remove this axiom from the realm of popular acceptance and submit its elaboration to scientific tests, we are met at the outset by the difficulty that these tests are themselves the subjects of theory and debate. Much has been said lately about the great facts of heredity. To anyone who approaches the question in this simple faith, conclusions will readily present themselves, although there is probably no scientific proposition which at the present time supplies more speculative thought. This much may be said at once to the credit of the science of eugenics, that it promises to present us in time with an accumulation of statistics from which some definite conclusions may be drawn. The true scientific spirit

* *Social Life in Greece*, chap v.

will be absent, however, if we are not prepared to accept, from these statistics, conclusions that oppose those we hoped to arrive at when we set out. Some of the great facts of heredity are extremely doubtful. Many are nothing more than synthetic theories to account for certain recognised phenomena. As for the present application of the law of natural selection, let us guard ourselves against looseness of terms. Natural selection, as applied to man, does not operate in the time that it takes him to invent and maybe perfect a flying machine, probably not even in the time that it takes a widespread disease to appear and disappear. The condensation of the theory of natural selection into the popular phrase, "the survival of the fittest," has not been without its disadvantages. It is laid to the charge of Christian civilisation, and particularly of the medical profession, that we are preserving the unfit in the great mass of degenerates—the tuberculous, the alcoholic, the mentally defective, and the criminal—that we allow them to perpetuate the species, and that our success in preserving life in a particular direction is tending to its destruction in the general. It is also stated that while the birth-rate amongst the fit is rapidly approaching a minimum, the unfit continue to multiply more rapidly even than the normal. Thus are we interfering with the process of natural selection. Into the study of this proposition, which surely more than any other demands the support of ample facts, as yet it is to be feared unascertained, there have meantime been thrown all the theories of hereditary transmission of characters, ancestral and acquired, favourable and unfavourable, so that it is little wonder that, as the enquiry widens, the solution seems only to recede.

The falling birth-rate will scarcely be claimed even by the positive school of eugenists as a germinal defect, for statistics are provided to show that the decrease most markedly affects those who, from intellectual and social characteristics at least, are most fit to be entrusted with the future of the race. The decline in the birth-rate, which affects our older colonies as well as ourselves, coincides during the past twenty years with the increase in Japan, a country which so little dreads its future in this respect that it recently spent a whole day in hanging some of those whom it is pleased to call the unfit. We are familiar with the usually assigned causes for the decrease, such environmental conditions as the more advanced age at which women marry, the smaller number of illegitimate births, the decay of religious sentiment, etc. Pearson* believes that the diminished birth-rate in certain manufacturing towns followed directly upon the Factory Act, in that it destroyed the economic value of the child. Is the economic value of the child confined to the industrial classes? Not in the

* *The Problem of Practical Eugenics*, 1909.

opposite sense of expenditure. Why is it that so many advertisements offering situations specify "No encumbrances"? Does not modern civilisation foster other causes, some of them so civilised as not to be spoken of even in polite society?

While it may be argued that the declining birth-rate is adapted to present conditions, let us look at another aspect of it. From certain statistics concerned with the City of London, Heron† concludes that reproductive selection is at present working in the direction of national degeneracy. Before accepting this it would be well to note that he says, "The worse the sanitary conditions under which people live and the worse their physical and mental health the higher is the birth-rate." It may first be noted that in many statistical data, mental health, intellectual culture, and financial success are taken as invariably synonymous. Applied mathematics, though a perfectly accurate science, may grievously err if it implies the same accuracy to all statistical returns. It may also be reasonably inferred that the poor physical and mental health mentioned has an environmental connection with the overcrowding and bad sanitary conditions. This is reflected in Heron's main conclusion that "a higher net fertility is shown to be very markedly correlated with most undesirable social factors, under at any rate the present social conditions of a large city." Here at least the selective eugenist and the environmentalist may join issues. Seebohm Rowntree‡ has shown that nearly 30 per cent. of a typical English population goes short of the physical necessities of life, and it has long ago been demonstrated that numerous progeny is the accompaniment of conditions of poverty for reasons that are obvious. It has yet to be shown to what extent better conditions amongst the great mass of the lower industrial classes would lead to healthy children or simply to restriction in the size of the family. "Rapid multiplication of the unfit," says a positive eugenist, "is a self-stultified phrase, since unfitness and infertility rise and fall together." This, however, rightly applies only to the sterility noted in idiots and other terminal cases of individual degeneration, and cannot even be used to refute Heron's results because of the indefiniteness of his "unfit."

This, then, is the modern aspect of eugenics: to arrest this increase in the progeny of the unfit, to discourage the decrease in the progeny of the fit. The difficulty of determining who are the fit is only greater than that of determining the unfit, because our recent studies in heredity have been mostly concerned with the latter. Are our modern charities and our national hygiene so directed towards the unfit progeny that the selective death-rate is unduly interfered

† *Drapers' Company Research Memoirs*, No. 1, 1906.

‡ Quoted from Wells, *Mankind in the Making*, p. 93.

with? It would be wrong surely to look upon the reduction in infant mortality as an interference with natural selection in all cases. As to the selective value of degeneracy and its greater prevalence, even if that were proved, may it not be argued that the Great Selector may change His weapons to suit our varying vulnerability, and that, as we must inevitably fall before His shafts, we have only been spared by our acquired immunity to the acuter diseases to succumb, after the brief respite of our greater longevity, to more chronic and more complex diseases that accord with our altered conditions.

"The most merciful form of eugenics," said Galton,* "would consist in watching for the indications of superior strains or races, and in so favouring them that their progeny shall outnumber and gradually replace that of the old one." The principle of positive eugenics, which is the least readily accepted solution, must, it would seem, at present stand aside if for no other reason than this alarming increase of the unfit, which, if verified, would swamp us before any selective scheme could be tabulated, much less carried out. Even if we could, from our knowledge of heredity, select those best suited to transmit their ancestral qualities, we must admit that at no other time could so much be said for the truth of the statement that it takes all kinds of people to make a world. What if the superior race to be selected should happen not to be our own? Would the heavens not seem to fall?

What characters are we to breed for? The complex human machine is not like that of the animals, and when we breed those whom we can "mate or destroy as we please," we do so for certain points of present utility, not necessarily for the remote future. Galton† himself says "the continuance of a highly selected breed of men in our present civilisation would constitute an impossibility." That is, we must also turn our attention to the part of our civilised environment which may contain initial causes of degeneration. Having selected those parents who are fit to produce healthy children, we should have, until the progeny outnumbered and replaced the unfit, to isolate them and guard them, for surely a colony of healthy and healthy-minded men and women will not lack the curiosity to steal out at times, it may be under the pretence of studying the social conditions of the great unfit population which henceforth is to spend its time guarding the inner tabernacle where rests the racial ark? How are we to encourage them? By making it worth their while? Surely the beginnings of degeneracy for them. They are to be taught how to rear healthy children, and are to

* *Inquiries into Human Faculty*, p. 199.

† *Loc. cit.*

be endowed by the State. Already the State has granted an encouragement to parents in a restriction of the income tax, but it need hardly be pointed out that the fittest to survive nowadays is not necessarily the fittest to propagate. It has been said that the old age pensions money might have been better devoted to the endowment of parentage. It is not said that persons over 70 years of age constitute part of the unfit in this matter, but are we not here reminded of a certain box of ointment which might have been sold for three hundred pence and given to the poor?

Turning now to the unfit, we must confess that we are not yet in a position to say that pathological characters are transmissible from one generation to another in the same way as physiological ones, and we know that some process of regeneration has been going on, else should we be worse off than we are. It is an interesting fact that much of this question of degeneration has centred upon the mentally defective and insane. It is asserted that physical evolution has reached its limit, and that, as our civilisation puts increasing demands upon the nervous system, any further evolution will only affect the brain. In order, therefore, that we may advance, we must set ourselves to eliminate every form of mental and nervous weakness. There is certainly more evidence to support the hereditary transmission of mental disease than appertains to any other. Statistics of insanity have been carefully examined for years before the present mathematical tests were applied to them, and the process of segregating the insane, so loosely called their preservation, has been going on for at least a century. If they were less consistently segregated fifty years ago than they are to-day, why then are we not all insane? Not because there were fewer asylum recoveries or discharges then, nor because the environment was so bad as to eliminate the progeny. Rather because like only tends to beget like. Heredity on the physiological side transmits the biological features and maintains the average characters of the race; on the pathological side it strives, given good environment, to eliminate degeneration, which is not an attribute of heredity, but a disturbance of it.

With regard to the apparent increase of insanity deduced from asylum statistics, it must be noted that during the past twenty years there has been a wholesale clearing-up process at work in the segregation of the mass of defectives who were formerly permitted to roam about the country. Account must also be taken of the great numbers of senile cases which, in the absence of family care or other suitable provision, constitute such a large percentage of the asylum population. This process has too recently been undertaken to allow of proper deductions being made as to the actual increase of insanity. We recognise more and more every day that insanity is a bodily

disease. Too much attention was paid in the past to the psychic causes, and too much stress laid upon the psychic symptoms. No one is bold enough as yet to deny the hereditary transmission of insanity, but every day more light is thrown upon the exciting causes of it. There seems no reason to doubt the existence of the nervous diathesis, but this very fact of predisposition constitutes one of the greatest difficulties in dealing with insanity by other methods than those now in vogue. It would be of little use to dabble amongst the waste of a gaswork in the hope of improving the quality of gas. It may be made to yield useful by-products, and must be kept from returning into the process of manufacturing, but the quality of the coal is the question. What profit is it to apply eugenic measures to the insane other than segregation if still the progenitors of insanity cannot be detected? Predisposition to mental disease like any other may be eradicated without its ever having shown itself; suitable environment may see it very rapidly eliminated. Many a healthy family contains one imbecile, many of the relatives of insane persons are amongst those who are doing the world's best work, and in many cases the parents of an insane person might, before the evidences of their taint appeared in the progeny, have been selected as fit specimens for homo-culture. The percentage of insane relatives of asylum patients is not large, and it has not yet been accurately compared with the percentage of insane relatives amongst a body of the sane. It seems, therefore, somewhat difficult to understand one writer who says that "the greater part of feeble-mindedness, insanity, and criminality could be eliminated by segregation in one generation." It has been stated that much insanity is thrown upon the country by the discharge from asylums of recovered women of child-bearing age. It may be granted that every discouragement should be given to further child-bearing in most of these cases. Dr. Bond* has analysed a number, and points out that, at most, 10 per cent. of the insane appear to have an insane parent, and a similar percentage have an insane brother or sister, so that while eugenic measures in this direction might account for the prevention of, say, 40 cases of insanity, something like 350 cases must originate from progenitors whom these measures could not touch. All this but tends to show the dangers of hastily applying measures to the insane until our accumulated statistics can point to the stage at which the definite predisposition sets in.

In another class of the unfit—the criminal—there is difficulty not only in estimating the relative values of predisposition and environment, but in detecting the predisposition, if it exists, before the degenerative process reveals itself. There is ample evidence of the

* *Journal of Mental Science*, January, 1911, p. 176.

falsehood of extremes in the theories, on the one hand, that crime is in all cases the evidence of individual wickedness, on the other, that it is invariably an inherited mental defect. The tendency of some to ascribe all criminality to mental deficiency, to arrested development of certain brain cells in cases of fraud, to imperfectly acting neurones in cases of violence, and to moral insanity in every doubtful case, is scientific theory run riot. Is it possible that a fine or term of imprisonment so affects arrested brain cells that, roughly speaking, 70 per cent. of first offenders never return to crime?

Tuberculosis, which at one time was thought to be a disease of an unfailing hereditary type, has undergone modification since the discovery of the tubercle bacillus, and the greatly diminished death-rate during the past fifty years has demonstrated that at any rate predisposition is only one factor in causation. Looking to its enormous prevalence at one time, it is evident that the part played by heredity has been mostly shown in its power of eradicating the disease. It has been said that if we consider the facts that three generations back we have eight direct ancestors, and that not long ago 1 in 7 of the population suffered from tuberculosis in some form, we might without considering the question of immunity discount heredity altogether.

We look to the National Eugenics Laboratory for the accumulation of data that will place these doubtful questions in the realm of certainty. Since the consistent study of heredity began, the available statistics go back accurately for at most two generations. To build definite schemes on that short period is premature. It is unfortunate that already some of the pronouncements of the laboratory have raised the most heated discussion. It was recently stated by Pearson and Elderton* that, as a result of their study of family histories in connection with alcoholism, they found that the children of alcoholic parents show on the whole better health than those of the sober population. The opposition which this has evoked from many other competent observers intensifies the great need for care in the scientific elucidation of social problems if the public mind is to be influenced. One cannot too closely follow the methods of a careful investigator like Darwin, or Harvey who waited for ten years to invite discussion and verify his own conclusions before he could be persuaded to publish his discovery of the circulation of the blood. There is probably little truth but much of a moral in the story of the famous scientist who proved by the unalterable laws of physics that a golf ball could be driven a certain distance and no farther, till his son, an equally famous golfer, compelled him to modify his conclusions by far outdistancing the natural limit.

* From the Galton Laboratory.

At the present time, when the liberty of the subject carries with it such individual weight, any legislation to radically deal with these questions, though it need not be the hopeless task some believe it to be, will be extremely delicate and difficult. The medical world, unless it has absolutely incontrovertible data to present, need not expect too much consideration in an age when the undoubted benefits of a Vaccination Act had to yield at last to the claims of the conscientious objector. We do not do things so quickly in this country as in the State of Indiana, where a Bill to legalise the sterilisation of asylum patients has this simple preamble, "Whereas heredity plays an important part in the transmission of crime, idiocy, and imbecility, therefore be it enacted" . . . Any Bill to prevent the marriage of the unfit, when these have been properly demonstrated, must take note of the fact that there is such a thing as illegitimacy. In any selection of parentage it will be necessary to consider what modifications the natural instincts of love, marriage, and parentage have already undergone at the hands of our civilisation. The changing status of women forms in itself a great subject in relation to this question.

Much will be done by steadily proceeding with the segregation of the insane and the degenerates, but what of the forerunners of these whom legislation cannot and probably dare not touch? In time we may be able to deduce such facts from comprehensive family histories that medical boards may be empowered to veto certain marriages. It will be long, however, before most people can be persuaded to record more of their family history than is to be found in the fly-leaves of the old family Bibles. At anyrate, we may set ourselves against such loose hygiene as encourages marriage in a neurotic individual as a possible cure. Much may be done by continuing to raise the standard of public health, and we may select the best specimens for propagating the race quietly and without sacrifice of any human instinct by inculcating what is so highly desirable and may not be so far off, the individual health conscience, that healthy morality which will sacrifice individual gain for general progress, the goal of our altruism, which, if we seek it honestly, we may attain to more quickly by education than by compulsion.

How much of the great stress we lay upon heredity is due to our aversion to facing disagreeable facts of environment, how much of it because one half of the world could not bear to hear how the other half lives? Who can say what results would accrue were syphilis made a notifiable disease? Who can foretell the result if our country's finance were less bound up with one of its most prevalent vices, and some sort of compromise even were come to as to

the influence of alcohol upon individual and national degeneration? Any State that pretends to take its physical improvement in hand on scientific principles must also analyse its morality and submit its vices to the same tests. We know comparatively little yet of the effects of environmental influences upon the unborn child, the effects of bad nutrition and bad nursing upon the developing brain. At this stage of mental evolution it is absurd to tell us that in former times and amongst savage races children grew up without much care of any kind. There is no analogy. The developing child of to-day has countless needs, and it is good eugenics to supply these. Mr. Motion, of Glasgow, has shown what can be done even with the children of the slums by boarding them out in Highland villages under respectable home influences. Of thousands dealt with during the last twenty years, fully 90 per cent. do well in after life. It is not fair to turn on, as has been done, the inevitable light of heredity, and say that, as acquired characters are not transmitted, we must wait to see the offspring of these children before judging of results. Nor is it right to raise the objection that this removal of parental responsibility encourages fuller propagation on the part of the unfit. As these children are mostly waifs, such increase is not certain, and if they turn out healthy, physically and morally, who shall say their parents were unfit? May a State not legislate for good citizens in this way as in any other if the ultimate purpose is to make the fit preponderate? If the intellectually fit cannot in the future coincide culture or luxury with the expenditure or inconvenience of a family, and are likely to be the last to submit to legislative compulsion, the future of the race must be guided and encouraged surely in whatever region it appears. Many measures to improve the physique of school children have been the subject of ridicule. One sees too many good sets of teeth amongst criminals and lunatics to believe that decay is more the result of germinal degeneration than of civilised environment, and the uses of a toothbrush as part of a child's education may have better results than are thought of. Even if decayed teeth are more prevalent, let us not be put off with any far-fetched idea of an evolution to a type that needs no teeth, but recognise that in this, as in many other conditions, the tendencies of our civilisation need remedies evolved from civilised experiences. Thus only may we keep abreast of it.

The National Eugenics Laboratory has yet to prove its title to be considered a new school of biology. We hope for much from it. Meantime let us recognise that the measures we now employ are as yet only in their infancy, and let us go on applying every proved discovery of medical science to the improvement of national and

individual health, at the same time segregating the bodily unfit from our sense of altruism, and more than ever isolating the social degenerate on the grounds of order and decency. The growing expenditure, of which so much is said, has little bearing upon the question of what method is to be employed. Is it not a fact that after all we pay very little for the extraordinary liberty and safety we enjoy in this country? If the historian has ever to write the decline and fall of the British Empire, he may record that we talked much of racial improvement, but elected in our sentimentality and dishonesty to cling to our individual advantages. Ere that happens we may again be reminded that nature has never yet been really indebted to man for anything. Hardship and war may come again to test us. It will be well if our morality remains sufficient to make a salvage worth the while. We should remember, however, that a correct view of racial progress can only be got from the perspective which distance affords, so that while there is no excuse for idly disregarding suggestions for improvement, we may save ourselves from a condition of national hypochondria.

There are some thinkers who believe that natural selection does not apply to man, that it is impossible for him to be subject to laws which, ever since he reached the stage of reflection, he could modify to suit himself. There is here again the fallacy of viewing natural selection within the narrow limits of a generation. There is in our present attitude to the unfit evidence of an instinct of altruism which might reasonably be regarded as the latest phase of human evolution. "To spare future generations the depressing spectacle of poverty and ugliness, let what is ripe for death die; let us have the courage not to help those who fall, but to push them farther so that they may fall the quicker." This is the pitiless philosophy that led to Nietzsche's *Superman*, that ideal of human perfection who rises to happiness by an unfaltering stifling of pity. Even so our sensitiveness to suffering should be our ruin. But Neitzsche's philosophy was a reaction against that other which for nineteen centuries has helped to mould our moral sense and stimulated that instinctive altruism which bulks so largely in a creed like Tolstoi's.

We cannot in one generation arrive at the whole truth on these questions. We may only do our little to solve them, leaving it to our successors to reap the benefits and strive still further. "There is no such thing as the whole truth," said Stevenson. Deprived of certain unknowable facts, men at any rate will not cease to be intellectually contentious, even should physical contention disappear in a first great millennium of peace and universal brotherhood. "We know," said Galton, "that the conditions of existence here will become rigorous and increasingly so, and there will be retrogressions towards

lower types until the simplest forms of life shall have wholly disappeared from the ice-bound surface." If that be so, is it poor philosophy to ask, Why, then, all this fuss for the future if, after all, man's chief end is to degenerate? Is the end rather to come when the final product of human evolution, bristling with immunities and hereditary tendencies, no more, alas! to be transmitted, awaits his destiny, or still more perfected shall merge in the Divine? To these theorists, as to many of the too enthusiastic extremists on present-day questions, there is as yet only one safe answer, "There is nothing more certain than that both are right, except perhaps that both are wrong."

XV.—*Notes on Some Highland Rocks.*

By George F. Bates, B.A., B.Sc.

(Read 13th April, 1911.)

The first impression produced on the mind of the student, who approaches the rocks of the Scottish Highlands for the first time, is usually one of absolute helplessness in face of the endless variety of rocks met with in this area. A striking object lesson may be obtained by a cursory examination of a heap of broken road-metal, such as may be met with in many parts of Perthshire, composed of fragments of boulders dug out of the drift which is so widely spread over the surface of the county. Here will be found specimens of numerous types of Highland rock—schists, quartzites, diorites, dolerites, granites and other forms—all of which may possibly have been dug out of the same hole. This mixture of material has, according to the generally accepted view, been transported from its original home by the action of land ice, and it is often a matter of no little difficulty even to guess where it may have come from. Hence a heap of road-metal of this kind, although it may afford examples of many types of rock, is by no means a satisfactory place for collecting materials. To do this we must find the rocks *in situ*, and this is a task which will lead us by stream and loch, mountain and glen, into some of the finest scenery in Britain—a task which will bring its own reward, not only in the pleasure of investigating, in ever so slight a degree, some of the problems of Highland geology, but also in the physical enjoyment which such an excursion affords.

The complexity of Highland geology is, of course, due to the fact that with few exceptions the rocks are metamorphic. There can be no doubt that originally these rocks were just ordinary sandstones, shales, limestones, &c., now they are quartzites, slates, schists, and so forth. Once they lay in level or gently inclined strata, now they are crushed, folded, tilted, with their original characteristics and fossils, if they contained any, obliterated. Metamorphism has been described as "the production of new minerals, or new structures, or both, in pre-existing rock-masses" (Harker, "Petrology for Students," p. 297). Nowhere, perhaps, can the truth of this definition be better demonstrated than in the Scottish Highlands. The materials of the rock-masses have been in many cases re-formed, and a new generation of minerals produced; and almost everywhere we see a new structure, a schistose or fissile character, clearly developed. It will easily be seen that the agencies producing metamorphism, chiefly pressure aided by heat, acting over a wide area and on varied rock-masses, would give rise to rocks of very varied types. The degree of metamorphism would also, in all probability, be very variable. An enquiry into the origin and mode of action of the metamorphic forces is beyond the scope of this paper, but the subject is treated more or less fully in practically all the treatises on geology.

It is obvious that if any of the Highland rocks were formed after the metamorphic agencies ceased to act, these particular rocks would not possess the characteristics due to metamorphism. Such rocks are very widely distributed, though the aggregate area covered by them is very much smaller than that covered by the metamorphic rocks. As might be expected, they consist of igneous rocks intruded into the earth's crust at periods not exactly known, but subsequent to the general metamorphism.

We may therefore roughly classify the Highland rocks as follows :—

1. Metamorphic Rocks—
   - (*a*) Of clastic origin :—
     - Arenaceous—Quartzites and many schists.
     - Argillaceous—Clay-slate.
   - (*b*) Of organic origin :—
     - Limestone.
   - (*c*) Of igneous origin :—
     - Epidiorite, foliated granite.
2. Non-metamorphic Rocks—
   - The later igneous intrusions :—
     - Granite, diorite, and the numerous dyke-rocks.

It is not my intention in this paper to deal with any of the more commonly occurring Highland rocks. They indeed offer many

points of interest, and are well worthy of attention, but the subject is too vast. Those which occur more rarely will be found equally interesting, and they afford scope for much investigation.

The first type of rock to which I will draw your attention is very widely spread, but appears to have its highest development in the neighbourhood of Ben-y-Vrackie, from which as a centre it occurs over a broad belt extending north-east and south-west, *i.e.*, following the general "strike" of the Highland rocks. Its most persistent outcrop is just to the south of the schists which form the Farragon range, but altogether there must be hundreds of outcrops. Probably from the central mass of the rock at Ben-y-Vrackie numerous "sills" have spread out, but it is not to be supposed that every outcrop is a separate sill, because through the complex folding of the Highland rocks, and subsequent denudation, one sill might give rise to numerous exposures. The rock in question is almost black, with a distinctly greenish tinge, sometimes coarse-grained, sometimes fine, more or less obviously schistose, and often highly garnetiferous. Two or three exposures may be seen at Killiecrankie, just below the North Garry Bridge. The rock here is fine grained, and garnetiferous. Microscopic examination shows it to be composed chiefly of green hornblende, in prismatic crystals, the longer axes of which are all directed in approximately parallel directions, on account of which the rock readily splits in one direction, but is much harder to break across the grain. The interspaces between the hornblende crystals are filled with a colourless transparent material, which examination by polarised light shows to be composed of quartz and felspar, the former being predominant. Flakes of biotite occur here and there, together with garnets in a more or less fragmentary condition, and granules of a pale mineral, probably epidote. (Plate 8). The rock may be described as a garnetiferous hornblende schist. The rock from the summit of Ben-y-Vrackie is on the whole similar, perhaps not quite so fine grained and less obviously garnetiferous and schistose. (Plate 9.) Another specimen from near Loch Kynardochy is again of the same general type, rather coarser in the grain, and with a greater abundance of the ubiquitous iron ores.

The schistose character of the rock, and the presence of garnet, point to the fact that this is a metamorphic rock. The question of its original nature cannot be well answered from evidence supplied by rocks in the immediate neighbourhood of Ben-y-Vrackie, but when the rock is traced farther to the east it becomes locally a gabbro, *i.e.*, a plutonic rock consisting essentially of felspar and a pyroxene. The metamorphic agencies would seem therefore in this case, in addition to developing the schistose character, to have caused an alteration of pyroxene, of which the commonest variety is augite,

into hornblende, and to have caused the formation of garnet and other minerals not previouly existing as such. A rock consisting of felspar and hornblende, in which the hornblende has been derived from augite, is usually termed an epidiorite, and it is by this name that the rock under discussion is distinguished in the Geological Survey Memoir. An interesting point in connection with this type of hornblende schist, or epidiorite, is that it locally acquires a character apparently totally different from that of the typical rock, forming what is known as the "talcose phase." This variety is dark green, highly schistose, with a greasy feeling, and so soft that it can be scratched with the thumb-nail. It consists of chlorite, talc, and other minerals, and in spite of its soft character it forms an excellent building-stone, being easily worked and not susceptible to weathering. It was formerly extensively worked in the neighbourhood of Aberfeldy, and has recently been largely used for interior work in the additions to St. Ninian's Cathedral. It is difficult to give a satisfactory explanation of the origin of this talcose epidiorite: "the sill may vary in composition from point to point, or the difference in mineralogical constitution may not indicate a difference in chemical composition, but may be due to differences in metamorphism, or weathering, or both. The first of these hypotheses may be dismissed as highly improbable; the second offers an interesting suggestion for the study of these phenomena." (Geological Survey Memoir on Sheet 55, p. 74.)

Another variety of hornblende schist is very common, and is well seen on both sides of Strathtay below Aberfeldy. It is quarried on the right-hand side of the Aberfeldy-Crieff road and elsewhere, a large portion of the village of Aberfeldy being built of it. An outcrop of this rock also produces the well-known Falls of Moness. This hornblende-schist has been shown to be of clastic, and not igneous origin; it is more homogeneous than the igneous rock; two systems of joints are well-developed, and the rusty-looking appearance seen on the weathered surfaces of epidiorite is absent. Hornblende schists of this type constitute what are known as Green Beds.

I now wish to consider a series of dyke-rocks which are exposed on the banks and in the bed of the River Garry, within the first two or three miles above Struan. It is with a feeling of relief that one comes down to the rocks in the bed of a river. On the sides or summit of a mountain there is often very considerable difficulty in securing fresh specimens of rock. The weathered crust may extend inwards to a very considerable depth, and the exposed portions of the rock may offer few "points of attack" to the hammer; or the rock may be covered with drift, and that in turn by heather and

other coarse vegetation, till one despairs of getting fresh specimens by the use of anything weaker than dynamite. In the rocky portions of a river bed all this is changed. The rocks are clearly exposed, and in many instances the weathered crust is removed as rapidly as it is formed, and there is no difficulty in getting fresh specimens. Care must be exercised, however. A specimen apparently fresh may be found to be quite the reverse when critically examined, and considerable hammering may be necessary under the most favourable circumstances. Of course rocks vary widely in their susceptibility to weathering: the crust may be only a fraction of an inch thick, or it may be several inches.

The dyke rocks exposed in the bed of the Garry in the locality now under consideration are very favourably circumstanced. They are very different in colour from the rocks into which they have been intruded, they are readily accessible, and the alterations due to weathering only penetrate to a slight degree. Some half-dozen dykes cross the Garry in the area referred to, running approximately parallel to one another and to the "strike" of the Moine schists into which they are intruded. On the Geological Survey Map of the district they are all coloured and lettered alike, but it must not be inferred from this that the rock is of uniform type throughout; in fact, differences are obvious to the most casual observer. Taking these dykes in order from south east to north-west, and starting from the point where the Garry enters the wood just above Struan station, we find first two dykes not very far from one another, only one of which is shown on the map. They are composed of compact rock of a dull pinkish colour, with fairly conspicuous crystals of orthoclase felspar, and patches of dark green ferro-magnesian minerals, some of which have a distinctly prismatic form, and are recognisable as hornblende or its alteration products. The rock thus bears a general resemblance to that composing some of the dykes in the Schiehallion district. (See "Dyke Rocks of the Schiehallion District," *Trans.* P.S.N.S., vol. 5, p. 23.)

About half a mile farther up the stream a group of three dykes occurs, the distance between the lowest and highest being about a quarter of a mile. The lowest of these dykes crosses the Garry where it passes through a picturesque little gorge, with precipitous banks, and is readily seen in the rocky sides of the gorge. Fresh specimens are readily obtained on the left bank. The middle dyke is well exposed: the banks of the river where it occurs are less precipitous, and it is quite easy to scramble down to the water level. The third one occurs where the banks are quite low, and owing to the fact that it has not weathered so rapidly as the schists, forms a pictuesque ridge across the river, over which the water rushes in a series of

cascades. (Plate 10.) The rock composing the middle dyke is quite like that of the first dyke noted: its felspar crystals are, however, still more conspicuous, and the dark-green patches smaller and less numerous. The lowest and highest of the three dykes are composed of rock which differs in some respects from those previously mentioned, though there is a general resemblance throughout. It is distinctly darker in colour, and has a decidedly greenish tinge. It is not absolutely uniform, however, veins of darker and lighter material being intermingled. I have selected the rock of the highest dyke for detailed microscopic examination, and I have no doubt that it is fairly representative of the whole. The section shows, then, large numbers of distinct porphyritic felspars, both orthoclase and plagioclase, the former predominating, embedded in a ground mass consisting essentially of felspar, badly altered, together with a little quartz. Flakes of rich-brown biotite occur in "nests," and the ground mass contains abundance of green chloritic material, probably derived from biotite, and numerous grains of biotite. Another mineral, of some interest, is a very pale green pyroxene, probably diopside, which occurs in well-developed crystals throughout the section. (Plate 11.) It is very difficult to hit on a name for a rock of this kind—it is another example of the fact that Nature declines to fit her products into our classified lists. It is perhaps nearest to a diorite. The Geological Survey Memoir gets over the difficulty by giving it a geographical name—"Strowan porphyrite," the latter term hvaing reference to the porphyritic felspars which are so abundant in the rock. This perhaps is justifiable on the ground that the rocks "have a well-marked character of their own, and are not known at present to occur beyond the limits of this sheet." (Geol. Survey Memoir on Sheet 55, p. 119.)

Returning to our dykes in the bed of the Garry, about a mile farther on we come upon a very conspicuous dyke, or rather, judging by the angle at which it dips towards the S.E., a sill. It has already been noted that in the Highlands no distinction can be drawn between dykes and sills. This sill can readily be seen on both banks of the river, and its outcrop is also visible for a considerable distance on both sides. (See Frontispiece, Geol. Survey Memoir, Sheet 55.)

The rock is very compact, and of a bright red colour. Porphyritic crystals of quartz are disseminated in abundance through the ground mass. It is not easy to obtain fresh specimens: the exposed parts of the rock break up, under the action of the hammer, into useless splinters, and even at a considerable distance below the surface, a pitted appearance due to weathering appears with remarkable persistence.

Under the microscope the quartz crystals are the most conspicuous

objects, and their appearance shows some light on the history of the rock. We note in the first instance that they present, in a high degree, distinct crystallographic contours, showing that when they were formed there were no other crystals present to interfere with their growth, *i.e.*, they were formed while the magma was still fluid. Further proof of this is found in the fact that here and there corrosion has occurred, as if, owing to relief of pressure the already formed quartz crystals had begun to melt again. High magnification reveals the fact that the quartz crystals are crowded with inclusions, some of which at any rate are fluid, and do not fill the whole of the cavity in which they lie. These inclusions probably indicate that the crystals were formed under great pressure. Hence we may infer that what we now see as a compact rock was once a mass of fluid under considerable pressure in some subterranean receptacle. It had cooled down to such an extent that quartz crystals had formed, when by crust movements it was forced up into a crack, along which it ultimately solidified, but during these movements pressure was relieved to such an extent that the quartz once again became partly dissolved in the surrounding magma. The porphyritic felspar crystals in my specimen are very much altered and have quite an earthy appearance. They are probably orthoclase, as plagioclase is not likely to occur in so acidic a rock as this. These felspar crystals appear to occur always in close relation with the large quartz crystals, and are probably, like them, the product of the earlier stages of cooling. The ground mass is microgranitic, *i.e.*, it is very fine grained—to the naked eye it appears quite devoid of crystalline appearance—and contains the same minerals as granite, quartz, felspar, and mica, the latter being in the form of minute flakes of muscovite, and requiring a high power for their recognition. This ground mass confirms the tale of rapid cooling hinted at above—had it continued to cool slowly we should probably have had a typical granite. (Plate 12.) A rock of this type is commonly known as a felsite, and owing to the presence of the quartz phenocrysts, this particular rock may be termed a quartz-felsite, or quartz-porphyry. It is a highly acidic rock, and its relation to granite is obvious. It may, in fact, be looked upon as the volcanic, or sub-plutonic equivalent of granite, by which we mean, not that it was erupted from a volcano as a lava, but simply that it has cooled under slight pressure.

A little farther up the Garry we come across the "Approximate Outer Limit of Granite Veins," and the first of these veins may be found, with some little difficulty, in the bed of the river where it comes close to the Highland Railway. It is quite a small vein, and it is not by any means easy to obtain fresh material. Such as I have been able to get is extremely coarse grained, and consists very largely

of pink felspar,—"hand specimens" of quite a respectable size can be got, consisting apparently of felspar only,—quartz in irregular grains, large and small, and "nests" of mica crystals, often of considerable size, and from which typical six-sided crystals can be easily extracted with the point of a knife.

Typical granites are not abundant in the area covered by Sheet 55. One of the most accessible exposures is in Glen Tilt, about half a mile above Marble Lodge, and it can be easily examined in the bed of a small burn which here joins the Tilt on its right bank. There is another exposure in Glen Banvie, but I have not been able to visit this.

The Glen Tilt granite is rather coarse grained, and of a bright pink colour. Microscopically it shows the usual minerals of granite, or rather of granitite, for muscovite appears to be absent. The quartz is in the form of irregular grains, crowded with strings and lines of inclusions. It is quite fresh. The felspar is very interesting. The fresher crystals show the structure known as microperthite, consisting of orthoclase intergrown with plagioclase, which takes the form of narrow lamellae. Seen in one direction the plagioclase appears in the form of narrow strips crossing the crystal at an angle with the traces of the cleavage planes, and in another direction it appears as somewhat irregular patches. It might almost be compared to the medullary rays which form the "silver grain" in some kinds of timber, the two views referred to above corresponding respectively to the views at right angles and parallel to the grain of the wood. The name "perthite" is derived not from the "Fair City," but from Perth in Canada, where this type of felspar occurs in such a form that the intergrowth of the two varieties is visible to the naked eye. Ordinary plagioclase, recognisable by its multiple twining, also occurs. The biotite is in the form of irregular flakes, which in my specimen are, like the bulk of the felspars, rather badly altered. The only accessory mineral which I have been able to identify with any degree of certainty is apatite, which occurs in the form of prisms (longitudinal sections) and of six-sided grains (transverse sections). It is interesting to compare with the Glen Tilt granite the "foliated granite" which occurs farther to the east. The main mass forms the summit (above the 2000 feet contour line) of Ben Vuroch, but another exposure occurs in Glen Brerachan, and may be reached by taking the track which leads from that glen into the main north road about a mile and a half beyond Killiecrankie; or by ascending one of the burns that join the Brerachan water on its left bank. My specimens were taken from the outcrop near one of these burns. It is of a pale grey colour, almost white, obviously foliated, and containing abundance of mica (both brown and white) and garnet. Specimens taken within a few feet of each other show considerable differences.

Microscopic examination of a typical specimen shows the rock to consist essentially of quartz, felspar and two micas. The quartz is devoid of crystalline contours, and in the form of rounded grains, which form a brilliant mosaic in polarised light, owing to their being cut at different angles. Enclosures are by no means abundant. The felspar appears to be all orthoclase; it is locally crowded with flakes of muscovite. Brown mica is fairly abundant; and muscovite appears not only as inclusions in the felspars, but also in long strings of crystals. (The section was cut approximately parallel to the foliation). The garnet is of the usual type, but the crystals are not very good. (Plate 13.)

It is evident that we have here a rock which has undergone considerable alteration from a typical granite. The foliation of the minerals shows that it must have undergone considerable pressure. The garnet is also evidence of metamorphism; and the muscovite is also in all probability a "secondary" mineral, having been produced by alteration of the felspar. This mineral is also seen to envelop "eyes" of other minerals, as if it had actually been formed around them, or the rock had "flowed" under the influence of the pressure. It is not, however, necessary to suppose that the rock has ever been liquefied since its first formation—enormous pressures, acting over long periods of time, can produce strange results even in solid rocks.

This concludes the list of rocks to which I wish to draw your attention at the present time. I am only too conscious of the incompleteness and imperfections of my efforts, but hope I have succeeded in avoiding anything like serious inaccuracy, and shown you that the rocks upon which we so idly tread have a story to tell which is not altogether devoid of interest.

[This part, pp, 75-102, published December, 1911.]

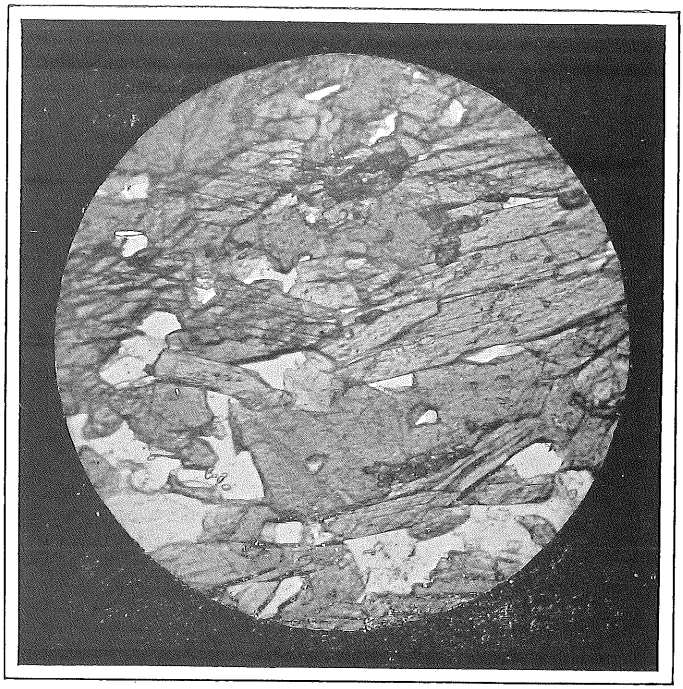


Plate 8—Hornblende Schist, Killiecrankie (x 87).

Plate 9.—Epidiorite, Summit of Ben-y-Vrackie (x 36).

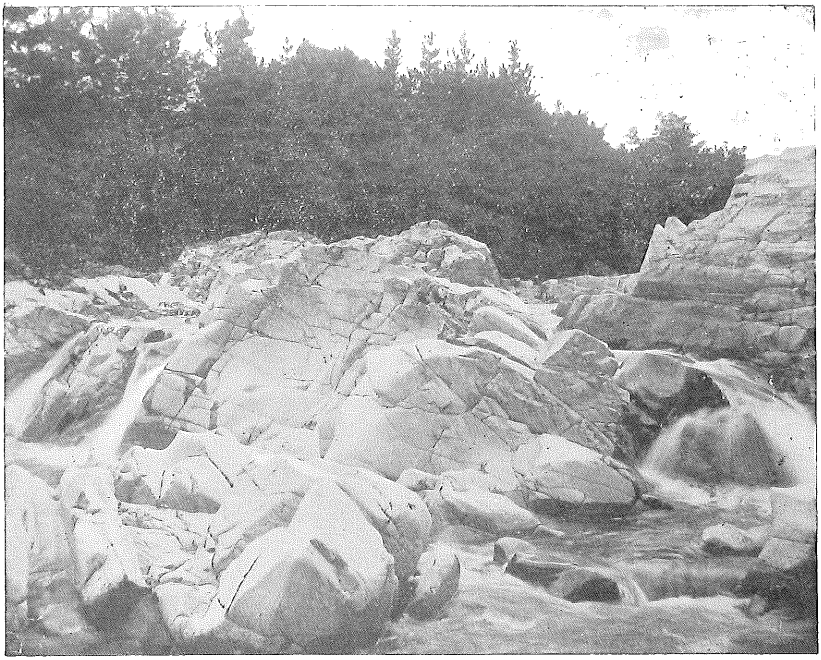


Plate 10.—Dyke of Strowan Porphyrite, River Garry.

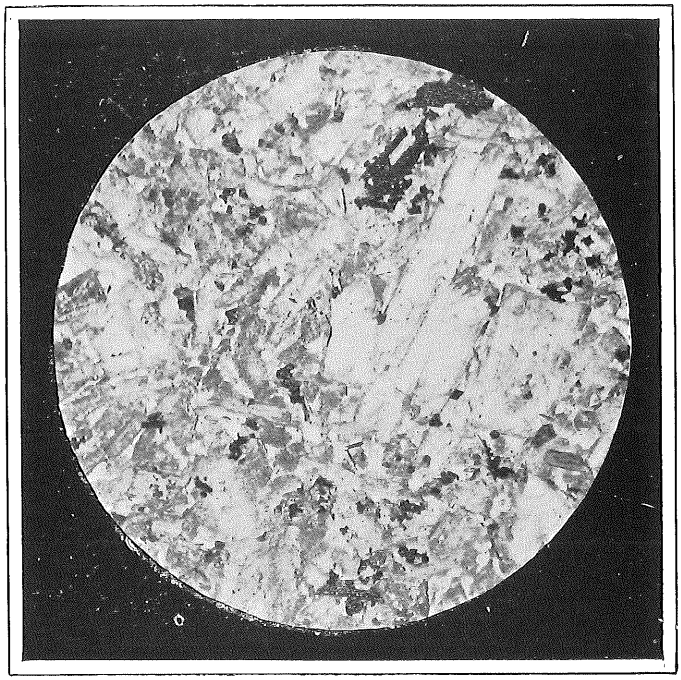


Plate II.—Strowan Porphyrite, River Garry (x 36).

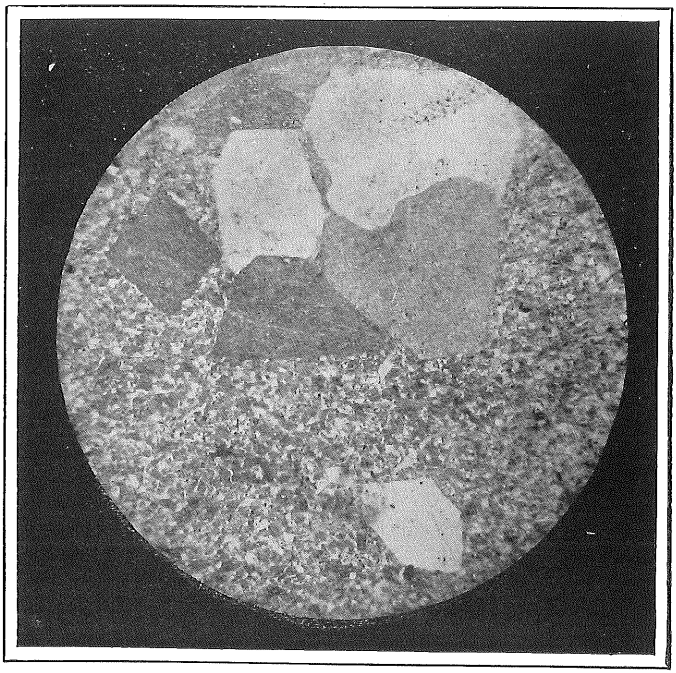


Plate 12.—Quartz Porphyry, River Garry (x 56).

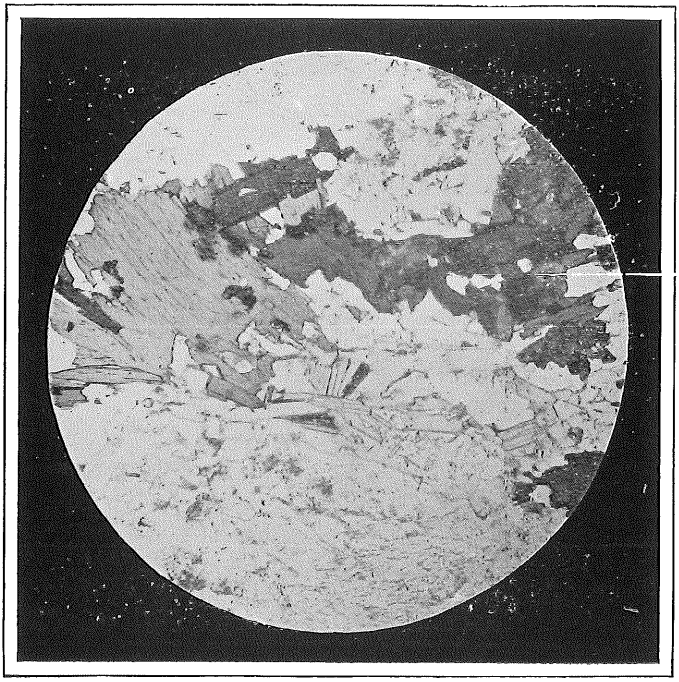


Plate 13.—Foliated Granite, Glen Brerachan (x 36).

XVI.—*A Pioneer in Criminology: Notes on the Work of James Bruce Thomson of Perth.*

By JOHN H. LYELL, M.D., Assistant Medical Officer, H.M. Prison, Perth.

(Read 14th December, 1911.)

Six years ago to-night I had the honour of reading to this Society a paper in which I dealt with the biological aspects of the criminal, and gave a brief sketch of the various opinions which had been arrived at by the school of Lombroso and his followers. I wish now to direct your attention to the work of a fellow-townsman of our own, who in many ways forestalled the conclusions of his more brilliant contemporary, and whose writings, though little known in this country, have achieved a Continental fame, and have still an important practical bearing upon many pressing questions of the present day.

The rise of a true scientific interest in Crime and Criminals only dates from about the middle of last century. From time immemorial the criminal had been looked upon merely as an evil-doer, to be punished or put out of existence according to the heinousness of his offence. Then came the period when the heroic labours of Howard and his fellow-reformers drew attention to the malefactor as an object of philanthropy, and immense pains were expended in the endeavour to improve his moral nature and mitigate the undue severities of his life in prison. It was long, however, before the idea occurred to anyone that criminals formed a class of beings by themselves, distinguished by peculiar mental and bodily characters which rendered them worthy of study as a special type of humanity. But a time at last arrived when notice was more and more directed to the physical and social causes of crime itself, and the true relation of the offender to the life of his normal fellows. The systematic investigation of criminality on a large scale is chiefly associated with the epoch-making work of the late Cesare Lombroso, which had for its object the consideration of the criminal in all his organic, biological, and psychological aspects. The great service rendered by Lombroso was to enforce the idea that criminality is not merely another name for human wickedness, but that it is rather a symptom of a deep-seated morbid process, having its roots far back in the past history of the race, and demanding attention, not so much from the metaphysical as from the pathological point of view. Lombroso, however, whose great work on the criminal was published in 1876, was not the first

to approach the subject in a true scientific spirit. It was in Scotland, in fact, that one of the earliest attempts was made to discover the real nature of the criminal instinct and its relation to physical abnormality and disease. To Dr. James Bruce Thomson, first resident medical officer of the Perth Penitentiary, is due the honour of being one of the earliest to investigate these questions in a systematic and unprejudiced manner.

Dr. Thomson entered upon his duties at Perth in the year 1858. The large Penitentiary, which about that date had been completed there, formed the General Prison for Scotland, and as it contained accommodation for over 800 prisoners, it afforded the amplest scope for the observation of criminality in all its sinister manifestations. Dr. Thomson held his appointment until his retiral in 1872, and during that period of fourteen years he contributed a series of important papers to the leading medical journals of the day, which may justly be said to have rendered his name famous as one of the founders and pioneers of the science of Criminal Anthropology.

About the same time we find such men as Dr. Forbes Winslow, founder of the British Hospital for Mental Diseases in London, Dr. Nicolson of Portland Prison, and Dr. Maudsley, the well-known lunacy expert, interesting themselves in the study of the criminal; while on the Continent, Lauvergne, Despine, and others, had taken up the subject. Their writings have not been forgotten, bnt none of them have attained the classical reputation of the works of Bruce Thomson. The reason for this is to be found in the remarkably clear and emphatic way in which Thomson expressed his views. His style is a model of scientific exposition. The remarkable extent of his observations, and the soundness and moderation of his conclusions, give his works a permanent value. His name is constantly referred to by present-day authorities, both British and Continental, as one of the first who grasped the fundamental problems of scientific Criminology.

Thomson's writings consist of a series of six papers in the *Edinburgh Medical Journal* for 1860-1861, entitled:—

"Statistics of Prisoners, their Mental Condition and Diseases,"

and another series of four papers in the *Journal of Medical Science* for 1866, 1867, and 1870, entitled:—

1. "The Effect of the Present System of Prison Discipline on the Body and the Mind."
2. "The Criminal Lunatics of Scotland." (Chiefly statistical).
3. "The Hereditary Nature of Crime."
4. "The Psychology of Criminals."

It is not my intention to deal in detail with these interesting articles, but rather to select a few of Thomson's most important conclusions with regard to the criminal, and to show their relation to present-day opinion on the subject. It is a remarkable testimony to his clearness of insight that, after the lapse of over 40 years, his writings have all the appositeness of current literature. Indeed, as I shall endeavour to show, the powerful movement in Criminology which Thomson helped to originate, having over-reached itself, has suffered a set-back almost to the point where he left it. The doctrines which he enunciated have therefore stood the test of time, and have an important bearing upon the theory and practice of the moment.

The leading impression which Thomson derived from his study of prison life—the impression which underlies all his conclusions and gives them scientific value—is that there is a criminal class, *sui generis*, constituting a distinct section of the community, with a "singular family likeness or caste," distinguishing it not only from the civil classes, but also from other criminal men. Let it be clearly kept in mind that Thomson's remarks do not apply indiscriminately to the whole crowd of prisoners who came under his observation. He fully recognised the obvious fact, which many writers ignore, that our cells contain a very heterogeneous assemblage of men and women, many of whom are simply unfortunates, perhaps more sinned against than sinning, and not deserving the name of criminals at all; while others belong to the large class of occasional offenders, who are derived from all ranks of life, and in no sense belong to the criminal classes, properly so called. It is true that in Thomson's day the Perth Prison contained a much larger proportion of major criminals than now. "The prisoners in Perth Prison," he tells us, "amount to about one-third of the whole criminals in Scotland, and belong to the most depraved and abandoned classes. They have been oftener and longer under imprisonment, frequently are of hereditary criminal families—born and bred in crime—their sentences running from nine months upwards to life-long detention." But even amongst these he was able to separate out a certain number who differed from the rest in several important respects, and his description of them is drawn with a graphic pen.

He pictures this specific class as having a locale and community of their own in our great cities. They never pursue an honest trade or profession, but constitute a set of demi-savages, preying in hordes upon society, their hand against every civilised man. Living in the midst of foul air and filthy lairs, and only associating themselves with those of their own nature and habits, they beget a depraved class

hereditarily disposed to crime. When seen in prison they exhibit a series of physical and mental peculiarities which render them readily recognisable amongst the crowd. Their features are coarse and clumsy, the face square and angular rather than oval, the complexion dingy, the expression stolid or brutal. Beauty or grace, even amongst the women, is conspicuously absent. They often present abnormal states, such as are found in all races or families where physical degeneration exists—spinal deformities, stammering, imperfect organs of speech, club-foot, cleft-palate, hare-lip, deafness, congenital blindness, epilepsy, scrofula, and so on. These usually accompany congenital weakness of mind. It would seem, says Thomson, that bodily and mental health are so linked together that deformity is at one time manifested and at another time mental disorder. Indeed, weakness of mind is peculiarly characteristic of the criminal class. Amongst over 5,000 prisoners, Thomson found 12 per cent. requiring special observation on this account, exclusive of those who became insane. The weakness of mind was mostly shown on admission or a few weeks after, proving that it was not due to the mere effects of imprisonment. There was found besides a great frequency of epilepsy amongst prisoners, amounting to nearly 1 per cent. Actual insanity occurred at the rate of 1 in 140, a large excess also over the proportion in the civil population. Thomson refers in another connection to a number of prisoners whose notorious irritability of temper and impulsive tendency to turbulence and disorderly conduct in prison could only be attributed to congenital weakness of mind, being illustrative of a mental condition closely allied to insanity. All who have had any experience of prison life at the present day are only too familiar with this type of criminal. Even under a milder discipline and shorter sentences, and though prisoners are as a class much less brutal than formerly was the case, the smashers and fighters and rowdies are always with us, and are as unamenable as ever to control. Dr. Milsom Rhodes, a man of large experience as a visiting justice, in a recent article in the *British Medical Journal*,* states that in his opinion more than 10 per cent. of prisoners are weak-minded, and that almost all of those who violate the prison regulations belong to this category.

Thomson's doctrine of the criminal is summarised in the following five propositions, which I may perhaps be allowed to quote verbatim:—

1. That there is a *criminal class*, distinct from other civilised and criminal men.
2. That this criminal class is marked by peculiar physical and mental characteristics.

* 27th June, 1908.

3. That the hereditary nature of crime is shown by the family histories of criminals.
4. That the transformation of other nervous disorders with crime in the criminal class also proves the alliance of hereditary crime with other disorders of the mind—such as epilepsy, dipsomania, insanity, etc.
5. That the incurable nature of crime in the criminal class goes to prove its hereditary nature.

It may be said that in these remarkable conclusions of Thomson we have the foundations of the modern science of Criminal Anthropology. The work of Lombroso and the great Italian and French schools is little more than an elaboration of doctrines almost precisely the same, brought into line with more recent biological theories, and treated according to the more exact ideas of present-day scientific investigation. Lombroso himself repeatedly refers to Thomson's observations, and acknowledges him as one of the masters and pioneers of Criminology.

The central doctrine in Lombroso's teaching is, in a word, the existence of what he calls the born or instinctive criminal—a person who represents a distinct type of humanity, being atavistic or reversionary to the savage and to primitive man in his biological relations, and exhibiting certain specific bodily and mental characters which distinguish him from his normal fellows and from other criminals. As regards physical characters, they are in the direction of deficiency or degeneration, such as are best seen in irregular development of the bones of the head and face. These, being among the most highly evolved and distinctly human parts of the frame, suffer, as it were, a reduction to a more primitive level, and this is accompanied by a degradation of the higher instincts acquired by long centuries of civilisation, and an emergence of the brute passions of bye-gone stages of savagery. From the very moment of its enunciation the conception of the instinctive criminal awakened the widest discussion, and the question whether or not there really exists such a human type, in Lombroso's sense of the term, is still exercising the minds of experts.

I propose in what remains of this paper taking up the main doctrine of what we may in a general sense call the Thomson-Lombroso school, viz., that of the existence of the specific criminal type, and enquiring how far we are justified in accepting it as a rule of belief and practice. It is clearly a question of great practical importance whether we are to believe that a certain number of men and women are so constituted by the inexorable laws of heredity as

to possess an innate disposition to crime, and to be doomed by the necessity of their natures to lives of vice and depravity. To say so would of course imply that the moral disease of such criminals is incurable, aud that all efforts to deal with them by the ordinary methods of punishment and reformatory treatment are wasted labour. There are many who will not accept the doctrine of specific criminality, as being a libel on the human race and a mere avowal of gloomy fatalism. Others again, and amongst them men who are deeply conversant with the criminal in all his aspects, are forced to admit that nothing short of an inborn propensity or instinct for crime can explain the hopeless incorrigibility of many offenders.

Let it be said, however, in the first place, that it is no more absurd to admit the existence of the instinctive criminal than to admit his opposite, viz., the man of instinctively virtuous and honest disposition. We all readily acknowledge that there are innumerable men and women whose high moral character is as much an innate quality as fine physical health or intellectual capacity. On the other hand, we also know that the world has always contained human beings essentially base, cruel and wicked, born, as the phrase goes, "with a double dose of original sin." The instinctive or born criminal in this sense is no mere figment of the imagination, as some have tried to show. He is a commonplace of history and a familiar figure in the law courts and prison cells of all civilised nations.

The retort, of course, may be made that from this point of view the instinctive criminal is nothing more or less than a very bad man, and to try and make a specific type of him is mere scientific pedantry. The fact, however, which Lombroso and his school lay stress upon is that the moral delinquency of the typical criminal is so bound up with a depraved physical nature that he must follow out his evil destiny as by a law of necessity, his character being at the same time stamped upon his lineaments in a manner which cannot be mistaken. The stigmata of criminality, in other words, are presumed to be pathognomonic, that is to say, given their occurrence in any person, the conclusion may be drawn that the peculiar moral defects will also be present.

It has been an easy matter to criticise the doctrine of criminal stigmata. We now recognise that when these abnormalities exist they are merely the well-known signs of physical degeneration; and it has been proved over and over again that they are also to be found in many persons who exhibit neither marked weakness of mind nor vicious tendencies; and, on the other hand, that some of the most depraved and incorrigible criminals, far from betraying bodily abnormality, are distinguished by their fine physique and prepossessing countenances.

The question therefore resolves itself into an enquiry as to the relation subsisting between criminality and degeneration. Upon the latter subject a vast amount has been written, but unfortunately there is still some confusion of ideas as to what class of phenomena should be specially considered as degenerative in character. The earlier writers, such as Morel and others, to a large extent confused degeneracy with disease. In a sense, of course, a number of morbid processes are of the nature of a degeneration of the tissues, and no doubt many authorities still use the term for conditions acquired during the lifetime of the individual as the result of stress or toxic invasion. Acquired degeneracy, however, must be carefully distinguished from true degeneracy in the biological sense. The latter consists, strictly speaking, in the presence of various deep-seated defects of a congenital or germinal origin, which place the organism from the very start upon a lower plane of vitality, and prevent it from attaining to the full development of the type. It is naturally with reference to congenital degeneracy alone that we can rightly speak of stigmata, and when these are many or conspicuous there can be no mistake in the matter. But to place undue importance, on the other hand, upon minute morphological changes as an evidence of degeneracy, is to ignore the fact that Nature often admits of large variations within the healthy limits of the type. When we have arrived at an exact definition of normal humanity, it will be easier to estimate what deviations therefrom are of a degenerative character.

While this is true it is an indisputable fact that many criminals show marked evidences of both congenital and acquired degeneracy, using the term in the more simple sense of departure from the high standard of bodily and mental endowment, which is characteristic of the active and useful citizen. A large number of the true criminal class, as we meet with them in prison, are weakly and deformed and diseased, stupid and awkward, ugly, or lazy, or shy, and so on. Having had to make a brief physical examination of every prisoner who has entered the Perth Penitentiary during the last seven years—over 16,000 men and women—I have been struck more especially with the poor condition of many of the criminals transferred to us from Edinburgh and Glasgow. The Governors of these prisons are in the habit of sending to Perth all the inmates they wish to get rid off, and thus the accumulation of "riff-raff" in our cells during the busy months of the year frequently amounts to a high figure. Deformities of all descriptions, the result of accident or disease, tubercular glands and sores, venereal disease in all its disgusting varieties, weaknesses of the heart and lungs, impaired digestion, different forms of malnutrition such as anæmia and alcoholic cachexia,

tumours, hernias of the most aggravated degree, disfiguring skin diseases, and so on, mark out this motley crowd as belonging to the dregs and waste products of humanity, and prove the close alliance between gross physical disability and crime. This does not always mean, however, that the two conditions are necessarily related as cause to effect. The simple fact must be remembered that if a man cannot earn his living because of some bodily disease or defect, he tends sooner or later to drift into pauperism or crime. The degenerate is an incapable, one of the great army of "the unfit," in the first place, and in many cases only secondarily, and often, by mere bad luck, a criminal. When the degenerate happens to be born "with a silver spoon in his mouth," and is well looked after by his friends, he may remain all his life a perfectly innocent, though not necessarily a useful member of society.

The truth is, however, that at present "the domain of anthropology, so far as regards the study of the outward conformation of the malefactor, is shrinking, while that of criminal psychology is expanding."* The attempt of Lombroso and his school to erect the instinctive criminal into an anthropological type has turned out a failure. After all is said and done, the main characteristic of the criminal is nothing more or less than his crime. He may or may not be a degenerate, or his criminality may be considered in itself a minor form of psychical degeneracy. But as far as regards specific criminal stigmata, they cannot be said to have real scientific value. On the other hand, the conception of the instinctive criminal as a purely psychological type is gaining ground. By freeing it from presupposed theories and factitious accretions we acquire a most comprehensive and useful category, into which we can bring a large class of men and women whose native bias to vice and crime is unmistakable. Whether we are to consider such persons, as Lombroso does, to be identical with what are known as "moral imbeciles," is a matter of opinion. We have the weighty authority of Maudsley for the view that moral imbecility is "no mere medical crotchet," but a genuine mental derangement, and closely allied to insanity.† Those who deny its existence, such for example as Louis Proal ‡ and others, argue that it is impossible for a human being to be altogether devoid of the moral sense. But it may be said that absolute deprivation of either the moral or intellectual powers is not necessarily implied in the term imbecile. It is all a matter of degree. The fact that moral imbecility is far less often met with in asylums than in the prison has perhaps contributed not a little to the scepticism with which it is regarded by many authorities.

* De Fleury. † Responsibility in Mental Disease, 1874.
‡ Le crime et la peine, 1892.

Viewing the instinctive criminal, therefore, as a being whose moral nature is imperfectly developed, whose intelligence is often deficient, and whose bodily frame is more or less debased—as a degenerate in fact, in the sense that he falls far below his normal fellows in the necessary equipment for filling his place honestly and worthily in the social sphere—viewing him in this light, we may in a general sense identify him with Thomson's specific criminal class, which has been described in the earlier part of this paper. What has been said will, I think, have made it clear that modern criminal anthropology has over-stepped its mark in striving after too accurate scientific methods, and that it is safest to keep to generalities on such an elusive subject as the criminal. The same may be said when we turn to the consideration of Thomson's third proposition, which deals with the interesting question of the heredity of crime.

This may be dismissed in a very few words. In the first place, it is absurd to imagine that any accurate study of family pedigrees can be made amongst the criminal classes. If it "takes a wise man to know his own father," we need not expect to get reliable information from the besotted inmates of a common jail. Many of them never knew their parents, or their brothers and sisters, the criminal classes being no more particular about the marriage law than about any other law of the land. No doubt many interesting genealogical trees are to be found in books on criminology, but they mostly represent exceptional cases, where means have been available by which personal information could be checked. A further difficulty arises from the fact that the development of the criminal instinct largely depends upon social environment and upbringing. Bad surroundings naturally foster the propensity, while we cannot doubt that many potential criminals are saved from themselves by a comfortable home and a sufficient income. Another point must also be borne in mind, namely, that owing to the irregular sexual relationships of criminals, and the long periods which they spend in prison, they cannot perpetuate themselves to any great extent. Notwithstanding these considerations, there is strong reason for believing that criminals recruit themselves as a class, and transmit their evil propensities to their offspring. An interesting light is thrown on the subject by a recent article in the *Eugenics Review*, in which the origin of pauperism and vagabondism is traced to the intermarriage of undesirables, and the propagation of their defects from generation to generation in accentuated degree. "We believe," say the authors of the article, "that the greater proportion of undesirables would be found connected by a network of relationship, and that pauperism is probably recruited from a few thousand families." The defects which they show are described as "drunkenness, theft, persistent laziness, mental

deficiency, or general weakness of character, manifested by want of initiative, or energy, or stamina"—in other words, the well known characters of the criminal classes. It is, perhaps, premature to accept such statements as proved in view of the perplexing difficulties—both biological and statistical—with which the subject of heredity has become surrounded. Nevertheless, the idea of the pauper and criminal classes being in a measure self-contained and self-propagative is consistent with many facts which are familiar to the prison official and the administrators of justice. Meanwhile, therefore, we may take these statements as confirmatory of Thomson's conclusion that "the criminal class is distinct from all other social classes, the moral depravity which they show being transmitted hereditarily through their families from generation to generation."

On the other hand, with regard to Thomson's fourth proposition, concerning the transformation of nervous disorders in heredity—that is to say, the alternation of insanity, epilepsy, dipsomania, and such-like conditions with criminality in degenarate families—the phenomenon has been so often observed as to be now beyond dispute. Asylum statistics are full of examples where the rapid extinction of a depraved stock can be traced through a whole gradation of mental and physical diseases, showing how the germ-plasm in certain cases has become so vitiated that even repeated intermixture with a healthy strain fails to check the morbid tendency. These form examples, where, as Morel points out, the process reaches such limits that humanity is preserved by its excess. The probable association of criminality with this transformation of deep-seated disorders is certainly a blessing in disguise, for it leads us to assume that criminals in many cases share in the relative sterility of all degenerate stocks, and hence their existence tends to remain so far a stationary element in the community—if not a decreasing quantity.

The incurability of crime in the criminal classes, which is the subject of Thomson's last proposition, forms the natural corollary to the whole study. "The fact," he says, "that time after time the criminal classes lapse into crime, and are rarely improved by any form of prison discipline, shows that crime (in the general) is a moral disease of a chronic and congenital nature, and intractable in the extreme." This conclusion has been confirmed over and over again since Thomson's time.* The objection, of course, may be made that

* "It seems to be generally accepted," says Dr. Quinton in his book on "Crime and Criminals" (1910), "that a person who deliberately adopts crime as his profession, and earns his living by it, is to all intents and purposes a moral incurable, whom the criminal law cannot either reform or deter from crime" (p. 75).

the reason for the incurability of crime is that the right methods of correction and repression have not yet been discovered. "You stick a criminal in a cell," says a French writer,* "abandoning him to his perverse thoughts, or you throw him amongst beings as degraded and corrupt as himself—it would truly be a marvel if he went out less wicked than when he came in." To imagine, however, that there can ever be a panacea for human depravity in any possible form of prison administration is a vain hope. The prison, to the end of time, must perform the primary function of punishment, and any reformatory element which is introduced must in the nature of things be a mere compromise. This does not, however, by any means exclude every laudable plan which philanthropy can devise for reclaiming the criminal. The incurability of crime is like the incurability of every other disease—it cannot be absolutely proved till all attempts have failed to prove the opposite.

It would lead us too far at this stage to follow up the question of the treatment of the criminal with a view to his reform, one of the most complex and difficult problems which has ever exercised the mind of man, and upon which whole cart-loads of books have been written. Thomson's suggestions are that measures must be taken to break up the cast and community of the criminal classes, long sentences of habitual criminals being necessary in order to lessen the number of offenders, while juveniles must be brought under very early training if we hope to reclaim them. It is interesting to note that the Prevention of Crimes Act, and the Probation of Offenders Act, both passed only a few years ago, to a large extent embody these very principles, but some time must yet elapse before their beneficial effects can be determined.

The further lesson which Thomson taught us, viz., that crime is nearly allied to insanity, has not been lost, and more and more we are coming to see that by making criminality a psychological study, we are more likely to arrive at rational conclusions, than by merely looking at crime as the work of the devil, and pinning our hope of salvation upon the rigours of the penal code. "There is little doubt," says Thomson, "that if medical testimony were received by judges, especially in regard to old incorrigible offenders, the law would recognise doubtful responsibility and a low state of intellect in many habitual criminals, to such a degree as to affect the sentences awarded." This statement, made 40 years ago, may be compared with the general conclusion arrived at by the Societé Général des Prisons of France in 1905.† After a most elaborate collation of the opinions of innumerable authorities in different countries, it was

* Francotte, "L'Anthropologie Criminelle."

† Archives d'Anthropologie Criminelle, 1905.

almost unanimously agreed that "there exists a group of criminals of limited responsibility of which for the most part legislatures take no account; that it is necessary to apply special measures to this category of criminals, and while at the same time maintaining the principles of social defence and of intimidation by punishment, to isolate them until at least some notable improvement takes place in their condition."

In conclusion, let me remind you that the ground covered in this paper is of a highly controversial nature, and will remain so for many years to come. The value of Thomson's work lies in the fact that he wrote from intimate personal knowledge of his subject, and I think I have been able to show that he grasped in a remarkable way many of the fundamental problems of scientific criminology, and threw an interesting light upon their solution. In having brought his works before you, I am therefore convinced that I have not been conducting a dry historical enquiry, of merely academic interest, but that in these writings is contained matter of practical importance in relation to questions which are still far from a satisfactory answer.

XVII.—*A List of the Macro-Lepidoptera of the Kinfauns District, with a General Description of some of the Rarer Forms.*

By W. Wylie.

(Read 14th December, 1911).

After again looking over the *Transactions* of the Society, I see mention has been made of most of the collecting grounds for insects around Perth, including Moncreiffe and Kinnoull Hills. To my surprise, however, I see no mention of the Macro-Lepidoptera taken in the Kinfauns district, and as this is an ideal hunting-ground, and within easy reach of Perth, I think it right that some record should be given of the Macro-Lepidoptera which have been taken in it. However, before giving a detailed list of the species taken in the district, I think I had better give a short description of some of the rarer species, as I am certain their habits are not known, unless to some of the more advanced entomologists.

Perhaps the rarest species found in the Kinfauns district is *Noctua sobrina*. For many years this species was considered to be confined entirely to the Rannoch district of Perthshire, but some years ago, when searching for nocturnal larvæ in spring, I picked up amongst other noctuas a number of small larvæ of a chocolate colour, with a

row of white dots along the back. I reared them amongst the others on bilberry, and to my astonishment in autumn I bred out a number of *Noctua sobrina* perfect specimens, and entirely different from the species when taken at sugar or bloom. I consider the best time to get the larvæ is during April, when the bilberry is in bud. At this time the young larvæ must come to the bud to feed, and are therefore quite easily swept off. I have always found the larvæ more plentiful in glades where the food plant is not too rank, and the wood not too thick ; in fact, the shorter the plant the more chance one has of getting the larvæ. *Noctua sobrina* is a true bilberry feeder, and though I have tried to rear it on several low plants, I found it was almost impossible unless on bilberry. The larva of this species is very much subject to the attack of numerous ichneumon flies, and entomologists, though they get a good number of the larvæ in the spring, need not be disappointed if perhaps only about a third will reach the imago stage in autumn.

As I do not intend following the scientific order of the list here, I think the next species in rarity is *Dasydia obfuscata*. This species is very local, and is practically confined to one ridge near the centre of the Deuchney Woods on the Kinfauns Estate. The larvæ hibernate throughout the winter, but may be found from May to August on heather. Strange to say, I have found many times both the ova and larvæ of this species while searching for the imago. The heather bloom attracts both sexes of *obfuscata*. The males may be taken either alight on the heather, or else darting or hovering over it. They are very swift on the wing and difficult to capture. The females, on the other hand, seek cover during the day, but when darkness falls they emerge from their concealment and hang with drooping wings to a stem of heather, and in this position they are quite easily seen and boxed without the aid of a net. The specimens of *obfuscata* taken in this locality are very much admired by collectors in the South because of the fine markings on many of the species. Though I have had the pleasure of seeing some good collections of Lepidoptera, I have found very few females of *obfuscata* included amongst them. This, of course, is not to be wondered at, owing to the dangerous and rocky situations which this insect prefers. For this reason it is impossible in some parts of Scotland to search for this insect at night. Of course during the day males may be taken amongst the heather, but I have very seldom raised the females. For many years I have had the ova and larvæ of *obfuscata*, and, though I have tried to establish them in several places on Kinnoull Hill similar to that on Kinfauns, they have all proved unsuitable.

As I have described the habits of this species here, I hope collectors will not be too hard, as owing to the restricted area this

insect occurs in, it would be easy to exterminate it. However, I am happy to say I have known *obfuscata* to be on this ridge for over twenty years, and I have found even during the past year (1911) they were as abundant as when I first took them. I may mention that, at the time at which *obfuscata* occurs, this ridge is one of the beauty spots of Kinfauns Woods, the hill being one mass of purple heather.

Another species taken in the same district as *obfuscata* is *Agrotis agathina*. This insect is extremely rare in this locality, and on no occasion have I taken more than five or six specimens. *Agathina* has only occurred here within recent years. Both sexes are attracted by the heather bloom, and once settled are easily captured. As the larvæ of *agathina* are very difficult to rear, the best way of procuring specimens is to search for the imago at night.

Notodonta chaonia is another rare insect occuring in the Kinfauns Woods north-east of the Curling Pond. The ova of this species are white in colour and are laid on the under side of the leaf, but I have found them on the young buds before the leaves burst. When young, the larvæ have a peculiar habit of lying along the middle rib of the leaf, and in this position they require some searching for. I think the best way to get the larvæ is to bend over the lower branches of oaks and search carefully the leaves; the colour of the larvæ is green. On two occasions I have found the larvæ of *chaonia* full grown crawling down the trunks of trees to pupate. The larvæ spin a stiff cocoon in the soil, and have been known to lie in this stage for two years.

Another of the Notodonta family, *Notodonta tripida*, also occurs in the Kinfauns Woods. This species I consider much rarer locally than *chaonia*. I have only taken two larvæ in the Kinfauns district, and although I searched over a large area I was unsuccessful in getting more. Perhaps they were feeding further up the trees. The habits of the larvæ are much the same as *chaonia*. The colour of the larvæ when full fed is green, with yellowish stripes down the whole length of the caterpillar, and the ventral area of the body is tinged with purple at the extremities, which gives the larvæ a very handsome appearance. I may mention that six of the Notodonta family occur in the Kinfauns Woods.

Another species I would like to describe is *Hydræcia nictitans*, not because of the rarity of this insect, but owing to the great number of varieties occurring. Nearly all the varieties mentioned in Tutt's "British Noctuae" have been taken in the Kinfauns Woods; in fact the varieties are more numerous than the type, and some of them very rare, including var. *Rosea*, a bright clear red form, and var. *Obscura*. The colour of the latter variety is dark, inclining to blackish, and this metallic form occurs but rarely. The late Mr.

Tutt, in his "British Noctuae," mentioned var. *Obscura* as very rare. He had occasionally taken it at Deal, and had one specimen from Perth. *Obscura Rufa* is another var. of *Nictitans* which I have taken in Kinfauns Woods, and having forwarded specimens to the late Mr. Tutt, he replied saying it was the first time he had seen this form. Some seasons *Nictitans* is very abundant on the ragwort, and can be taken in great numbers. The best time for procuring this insect is in the beginning of August during the daytime, the males flying readily in the sunshine.

Agrotis obelisca is another rare insect, in fact I have taken it in no other localities than Kinnoull and Kinfauns Woods. This species is very often taken for forms of *tritici*, and in consequence I have many times had sent me specimens of *tritici* for *obelisca*. However, I was not surprised at this owing to the great variation in this insect, and often when collecting I thought I had *obelisca*, but on closer examination found I had only forms of *tritici* As far as I know, the only localities for *obelisca* are Fresh Water, Isle of Wight, Ayton, Berwick, and Perth. The moth appears on the wing in August, and comes readily to sugar and ragwort bloom.

When speaking of the Noctua I should have mentioned *Noctua glareosa*. The ground colour of this species has a wide variation, which extends from a pure whitish grey to a very dark form, but the black transverse lines are very constant in all its forms of variation, and stand out conspicuously even in the blackest forms. These black forms I believe are almost entirely confined to the Shetland Isles, and are very rare elsewhere. However, I have taken two or three specimens of this form on Kinnoull Hill. Another variety, tinted with a delicate rose colour, is also found not uncommonly in the Kinfauns Woods. In some seasons *Noctua glareosa* is very abundant both at sugar and on heather bloom.

Another Noctua, namely *Cirrhoedia Xerampelina*, is a very rare insect in the Kinfauns district, and in fact in Scotland. I have taken the larvæ of this species on ash beyond the Barnhill Toll House close to the river. The larva is of a grey colour and is very peculiar in form, seemingly tapering from the head backwards. The few times I have taken this larva have been at dusk during April, searching the ash trees with a light. Although I have searched the crevices of the same trees during the day I failed to find any larvæ.

Seemingly they conceal themselves about the ground in the daytime, and when darkness falls they scale the trees to the leaves; however, when I found the larvæ the ash was in bud. This insect seems to be pretty widely spread, as I have taken the imago near the tower on Kinnoull Hill in September. Possibly the insect had been carried over the cliffs with the wind.

Before concluding the Noctua I would mention another fairly rare insect, namely *Stilbia anomala.* I have taken this species at Kinfauns on heather bloom and amongst grass during August.

The Eupithecia are another group of Lepidoptera, entirely different from any of the families mentioned. This group occurs pretty abundantly in the Kinfauns Woods, and I think there are something like a dozen different species which have been taken. Some are very common; for example, *Eupithecia laricata* may be taken in the larvæ stage from almost every larch tree, and *Eupithecia absinthiata,* since some of the woods have been cut down, occurs very commonly on the ragwort. However, the rarest is *Eupithecia togata.* This species was considered until a few years ago a great rarity, and I think it should interest all members of our Society, as its habits were discovered by two of our late members, namely Sir Thomas Moncreiffe and W. Herd. The larvæ of *togata* were at first thought to feed upon the young shoots of the spruce, but in reality it feeds upon the ripe seeds which it finds at the base of the scales of the cones. The colour of the larva is of a dull pink, more or less spotted with black. When full fed it quits the cone and spins a slight cocoon on the surface of the earth. I may also mention that this species is two years in the larva stage and often two in the pupa stage. The moth emerges in July, and I have found it in several localities in Kinfauns Woods. Before leaving this species I may say that I have often detected from the ground, where the larvæ of this insect were feeding, owing to the quantity of frass hanging from the cone. In some cases I have taken as many as half a dozen larvæ in different stages from one cone.

Cidaria suffumata is another rare species occurring in the Kinfauns district, and it is notable that the variety *Cidaria piceata* is also fairly common, from the blackest types to intermediate forms of a nutty black colour. The larvæ feed on galium, and, where the plant occurs, the perfect insect may be taken in fair abundance on the trunks of trees, even during the day. Still another rare insect occurring in the Kinfauns Woods is *Macaria liturata.* The larvæ are on the needles of the Scotch fir, and are of a green colour with whitish stripes. The moth appears in July, but I have only taken three or four specimens, though I have made special search for this insect.

The last species I will describe is *Anticlea sinuata.* This insect is very rare in the Perth district, but I was fortunate enough to find a number of larvæ in August on lady's bedstraw (*Galium verum*) on the side of the Balthayock Road running through the Kinfauns estate. The larva is green with two black stripes running along the back, which gives it a distinguished appearance. The moth is on the wing about the end of June.

In concluding, I may say there are many more rare insects occurring in the Kinfauns district, but owing to restricted space I am unable to go into their life history at present, but perhaps at some future date I will give a general life history of most of the Macro-Lepidoptera taken in the Kinfauns district. However, before giving my list of Macro-Lepidoptera, I would like to thank the proprietor, the Right Hon. The Earl of Moray, for the privileges granted me for collecting in the Kinfauns district, which I think is one of the best collecting grounds for Lepidoptera around Perth.

RHOPALOCERA.

Pieris.
brassicæ, L. Common.
rapæ, L. ,,
napi, L. ,,
Argynnis.
selene, Schiff. Fairly common.
euphrosyne, L. ,,
aglaia, L. Rare.
Melitæa.
aurinia, Roth. Very rare.
Vanessa.
urticæ, L. Common.
atalanta, L. ,,
cardui, L. Rare.
Pararge.
egeria. L. Rare (confined to [cliffs).
Satyrus.
semele, L. Common, cliffs.
Epinephele.
ianira, L. Common.
hyperanthes, L. Common.
Cœnonympha.
pamphilus, L. Common.
Thecla.
quercus, L. Very rare.
rubi, L. Common.
Polyommatus.
phlœas, L. Common.
Lycæna.
artaxerxes, Fab. Rare.
icarus, Roth. Common.
minima, Fues. Rare.

HETEROCERA.

Sphinges.

Chœrocampa.
porcellus, L. Rare.
Smerinthus.
populi, L. Fairly common.
Macroglossa.
stellatarum, L. Rare.
Trochilium.
crabroniformis, Lewin. Fairly common. Larvæ stage.

Bombyces.

Sarothripus.
undulanus, Hb. Rare.
Hylophila.
prasinana, L. Fairly common.
Nola.
cucullatella, L. Rare.
confusalis, H. S. Rare.
Nemeophila.
plantaginis, L. Rare.
Arctia.
caja, L. Fairly common.
Spilosoma.
fuliginosa, L. Common.
lubricipeda, Esp. ,,
menthastri, Esp. ,,
Hepialus.
humuli, L. Common.
sylvanus, L. Rare.
lupulinus, L. Fairly common.
Orgyia.
antiqua, L. Fairly rare.
Pœcilocampa.
populi, L. Fairly rare.
Bombyx.
rubi, L. Common.
Drepana.
lacertinaria, L. Very rare.
falcataria, L. Very rare.

Dicranura.
furcula, L. Fairly rare.
vinula, L. Fairly common.
Lophopteryx.
camelina, L. Common.
Notodonta.
dictæa, L. Common.
dictæoides, Esp. Rare.
dromedarius, L. Common.
ziczac, L. Fairly common.
trepida, Esp. Very rare.
chaonia, Hb. Very rare.
Phalera.
bucephala, L. Fairly common.
Thyatira.
batis, L. Rare.
Cymatophera.
duplaris, L. Rare.
Asphalia.
flavicornis, L. Common.

Noctuæ.

Bryophila.
perla, Hb. Common.
Demas.
corlyi, L. Fairly common.
Acronycta.
psi, L. Rare.
leporina, L. Very rare.
rumicis, L. Fairly common.
Leucania.
conigera, Fb. Rare.
lithargyria, Esp. Fairly rare.
comma, L. Common.
impura, Hb. Common.
pallens, L. Common.
Tapinostola.
fulva, Hb. Rare.
Hydrœcia.
nictitans, Bork. Common.
micacea, Esp. Rare.
Xylophasia.
rurea, Fb. Common.
lithoxylea, Fb. Fairly rare.
Cloantha.
polyodon, Clerck. Common.
Neuronia.
popularis, Fb. Rare.
Charæas.
graminis, L. Common.
Luperina.
testacea, Hb. Rare.
cespitis, Hb. Rare.
Mamestra.
brassicæ, L. Common.
Apamea.
basilinea, Fb. Common.
gemina, Hb. Fairly common.
unanimus, Tr. Common.
ophiogramma, Esp. Very rare.
didyma, Esp. Common.
Miana.
strigilis, Clerck. Common.
fasciuncula, Haw. Common.
literosa, Haw. Common.
bicoloria, Vill. Fairly common.
Stilbia.
anomala, Haw. Rare.
Caradrina.
alsines, Brahn. Rare.
quadripunctata, Fb. Common
Rusina.
tenebrosa, Hb. Common.
Agrotis.
suffusa, Hb. Rare.
saucia, Hb. Rare.
segetum, Schiff. Common.
exclamationis, L. Common.
nigricans, L. Common.
tritici, L. Fairly common.
obelisca, Hb. Rare.
agathina, Dup. Very rare.
strigula, Thnl. Common
lucernea, L. Rare.
Noctua.
glareosa, Esp. Common.
depuncta, L. Rare.
augur, Fb. Common.
c-nigrum, L. Common.
triangulum, Hufn. Fairly common.
brunnea, Fb. Common.
festiva, Hb. Common.
v. conflua, Tr. Common.
dahlii, Hb. Rare.
umbrosa, Hb. Fairly common.
baia, Fb. Common.
sobrina, Gn. Very rare.
castanea, Esp. Fairly rare.
xanthographa, Fb. Common.

Triphæna.
ianthina, Esp. Common.
fimbria, L. Common.
interjecta, Hb. Rare.
orbona, Hufn. Common.
pronuba, L. Common.
Amphipyra.
tragopogonis, L. Common.
Mania.
typica, L. Common.
maura, L. Rare.
Panolis.
piniperda, Panry. Fairly common.
Pachnobia.
rubricosa, Fb. Rare.
Tæniocampa.
gothica, L. Common.
incerta, Hufn. Common.
stabilis, Vien. Common.
pulverulenta, Esp. Fairly common.
Orthosia.
suspecta, Hb. Fairly rare.
upsilon, Bork. Rare.
lota, Clerck. Rare.
macilenta, Hb. Common.
Anchocelis.
rufina, L. Fairly common.
litura, L. Common.
Cerastis.
vaccinii, L. Common.
Scopelosoma.
satellitia, L. Common.
Xanthia.
fulvago, L. Common.
flavago, Fb. Common.
circellaris, Hufn. Common.
Cirrhœdia.
xerampelina, Hb. Very rare.
Calymnia.
trapezina, L. Common.
Dianthœcia.
capsincola, Hb. Rare.
cucubali, Fues. Common.
Hecatera.
serena, Fb. Fairly common.
Polia.
chi, L. Common.
Dasypolia.
templi, Thub. Rare.
Aporophyla.
nigra, Haw. Rare.
Cleoceris.
viminalis, Fb. Common.
Miselia.
oxyacanthæ, L. Common.
Agriopis.
aprilina, L. Common.
Phlogophora.
meticulosa, L. Common.
Aplecta.
nebulosa, Hufn. Common.
tincta, Brahm. Rare.
Hadena.
adusta, Esp. Rare.
protea, Bork. Common.
glauca, Hb. Rare.
dentina, Esp. Rare.
oleracea, L. Common.
pisi, L. Rare.
thalassina, Roth. Rare.
rectilinea, Esp. Rare.
Calocampa.
vetusta, Hb. Common.
exoleta, L. Common.
solidaginis, Hb. Rare.
Cucullia.
umbratica, L. Rare.
Gonoptera.
libatrix, L. Rare.
Habrostola.
tripartita, Hfn. Rare.
Plusia.
chrysitis, L. Rare.
festucæ, L. Rare.
iota, L. Common.
pulchrina, Haw. Common.
gamma, L. Common.
interrogationis, L. Very rare.
Anarta.
myrtilli, L. Common.
Euclidia.
mi, Clerck. Rare.

Geometræ.

Rumia.
luteolata, L. Common.
Venilia.
macularia, L. Fairly rare.
Metrocampa.
margaritaria, L. Common.

Ellopia.
prosapiaria, L. Fairly rare.
Selima.
bilunaria, Esp. Fairly common.
Odontopera.
bidentata, Clerck. Common.
Crocallis.
elinguaria, L. Common.
Eugonia.
alniaria, L. Rare.
erosaria, Bork. Rare.
Himera.
pennaria, L. Fairly common.
Phigalia.
pedaria, Fb. Common.
Amphidasys.
betularia, L. Common.
Cleora.
lichenaria, Hufn. Very rare.
Boarmia.
repandata, L. Common.
gemmaria, Brahm. Fairly common.
Gnophos.
obscuraria, Hb. Fairly rare.
Dasydia.
obfuscaria, Hb. Local.
Zonosoma.
punctaria, L. Fairly rare.
Venusia.
cambrica, Curt. Rare
Acidalia.
bisetata, Hufn., Bork. Rare.
aversata, L. Rare.
Cabera.
pusaria, L. Common.
exanthemata, Scop. Common.
Macaria.
liturata, Clerck. Very rare.
Halia.
vauaria, L. Common.
Ematurga.
atomaria, L. Common.
Bupalus.
piniaria, L. Common.
Aspilates.
strigillaria, Hb. Common.
Abraxas.
grossulariata, L. Common.
Lomaspilis.
marginata, L. Fairly rare.
Hybernia.
rupicapraria, Hb. Common.
leucophæaria, Schiff. Common.
aurantiaria, Esp. Common.
marginaria, Bork. Common.
defoliaria, Clerck. Common
Anisopteryx.
æscularia, Schiff. Common.
Cheimatobia.
brumata, L. Common.
boreata, Hb. Common.
Oporabia
dilutata, Bork. Common.
filigrammaria, Hs. Fairly rare.
Larentia.
didymata, L. Common.
multistrigaria, Haw. Common.
cæsiata, Lang. Common.
viridaria, Fb. Common.
Eupithecia.
succenturiata, B. Rare.
nanata, Hb. Fairly common.
indigata, Hb. Common.
castigata, Hb. Common.
togata, Hb. Rare.
lariciata, Frr. Common.
absinthiata, Clerck. Common.
tenuiata, Hb. Fairly rare.
minutata, Gp. Rare.
vulgata, Haw. Common.
rectangulata, L. Rare.
assimilata, Gp. ,,
abbreviata, Sp. Common.
Thera.
variata, Schiff. Common.
firmata.
Hypsipetes.
ruberata, Frr. Rare.
trifasciata, Bork. Common.
sordidata, Fb. Common.
Melanthia.
bicolorata, Hufn. Fairly common.
ocellata, L. Common.
Melanippe.
tristata, L. Common.
sociata, Bork. Common.
montanata, Bork. Common.
fluctuata, L. Common.
Anticlea.
cucullata, Hufn. Rare.

Anticlea.
badiata, Fb. Common.
nigrofasciaria.
Coremia.
unidentaria, Haw. Common.
Camptogramma.
bilineata, L. Common.
Triphosa.
dubitata, L. Fairly rare.
Eucosmia.
undulata, L. Rare.
Cidaria.
siterata, Hufn. Rare.
miata, L. Rare.
corylata, Thub. Common.
truncata, Hufn. ,,
Cidaria.
immanata, Haw. Common.
suffumata, Hb. ,,
silaceata, Hb. Rare.
prunata, L. Common.
populata, L. ,,
fulvata, Forst. ,,
dotata, L. Fairly rare.
Eubolia
limitata, Scop. Common.
plumbaria, Fb. ,,
Chesias.
spartiata, Fues. Common.
Tanagra.
atrata, L. Fairly common.

XVIII.—*Notes on some Ectoparasites in the Museum, Perth.*

(Continued from Vol. V., Part II., page 50).

By James Waterston, B.D., B.Sc.

[Read 11th January, 1912].

To the nucleus of specimens referred to at the end of the first instalment of this paper there has been added, mainly through the zeal of Mr. George Hart, a considerable amount of new material from various hosts. The great bulk of this belongs to the order Mallophaga—the members of which live on feathers and fur. Skin-scabs, scurf, and extravasated blood from any wound are also devoured. Specimens from newly shot birds show, for this reason, a characteristic crimson median patch where the blood gorged alimentary tract shines through the unchitinised dorsum. Sometimes the colouring influence of the food goes further. Thus there is a form of *Larus ridibundus*, in which the normally white plumage of the breast and belly is considerably suffused with rosy pink. On such a bird the writer has recently met with a *Docophorus*, which in the immature individual had a prevailing tinge of salmon. As a rule the stage referred to is white. In this case the colour of the food had plainly affected the parasite. *Mallophaga* are seldom absent from birds, even when the latter are in good health. In nine cases out of ten, where no parasites have been found, their presence may be demonstrated by rigorous hand-picking of the feathers one by one. This is a counsel of perfection, but it will satisfy most doubters.

Less exacting methods, however, procure results of value. Whenever practicable the host may be put, as soon as dead, into a white cotton bag with close seams, and tightly tied. After twenty-four hours *Mallophaga* will be found on the head, especially at the base of the bill and on the quill feathers of the wing—in particular on the under coverts. On the bag itself more active forms, like *Menopon*, *Colpocephalum*, *Trinotum*, and *Physostomum*, will generally occur. Picked up with fine forceps, *Mallophaga* may be dropped into equal parts glacial acetic acid and absolute alcohol, and thereafter placed in alcohol of not less than 70 per cent. strength.

It is earnestly to be hoped that members of the Society with facilities for collecting will do all in their power to extend our knowledge of the local distribution of this presently—in Scotland at least—much neglected order.

Of the collection now noticed (about 280 examples), 3 specimens remain unidentified. There is a female *Menopon* from *Anas clangula*, and male and female *Goniodes* from *Aquila chrysaetus*. The latter is an interesting example of the parasite of the victim transferring itself to a bird of prey. These *Goniodes* are probably from a *Tetrao*. The arrangement followed is that of Kellogg, Genera Insectorum, 66me Fascicule (1908).

ORDER MALLOPHAGA.

I. SUB-ORDER ISCHNOCERA.

i. FAMILY TRICHODECTIDÆ.

Genus Trichodectes.

1. *T. crassus*, N. A long series, 16 males, 40 females, 31 immature, from Badger, *Meles taxus*, L., Aberfeldy, 3rd October, 1911. G. Hart.

FAMILY PHILOPTERIDÆ.

Genus Docophorus.

2. *D. aquilinus*, D.? (*a*) 4 males, 9 females, 1 immature from Golden Eagle, *A. chrysaetus*, L., Rannoch, 8th April, 1910. G. Hart. (*b*) 5 males, 6 females, from Golden Eagle, Aberfeldy, 24th January, 1911. G. Hart.
3. *D. rostratus*, N. Male and 5 females, from Barn Owl, *Strix flammea*, L., Strathord, 12th May, 1911. G. Hart.
4. *D. semisignatus*, D. Nec N. auct P. (= *albidus* P.) 4 males, 6 females, from Raven, *Corvus corax*, L. Brechin, autumn, 1910. G. Hart.
5. *D. subcrassipes*, N. Male and 2 females, from Magpie, *Pica rustica* (Scopoli), Strathord, 25th March, 1910. G. Hart.

[*D. bassanæ*, D. See below note 12].

Genus Nirmus.

6. *N. quadrulatus*, N. 10 males, 22 females, 10 immature, from Capercailzie, *Tetrao urogallus*, L. Perthshire. G. Hart, 1911.

Genus Goniodes.

7. *G. colchici*, D. Male, 5 females, and 5 immature, from Golden Pheasant, *Chrysolophus pictus*, Gray, Dunkeld, 24th January, 1911. G. Hart.
8. *G. falcicornis*, N. 15 males, 21 females, male and female immature from Peacock, *Pavo cristatus*, L., Gask, 18th July, 1911. G. Hart.
9. *G. chelicornis*, N. 2 males (not quite adult), 3 females, from Capercailzie *Tetrao urogallus*, L., Perthshire, 1911. G. Hart.

Genus Goniocotes.

10. *G. chrysocephalus*, G. One female, Golden Pheasant, Dunkeld, 24th January, 1911. G. Hart.

Genus Lipeurus.

11. *L. ochraceus*, N. 4 males, from Capercailzie, Perthshire, 1911. G. Hart.
12. *L. pullatus*, N. (= *staphylinoides*, D), 1 male, 7 females, 2 females apparently fresh from last moult, and 8 immature, from Gannet, *Sula bassana*, L., Dundee, 10th December, 1899. G. Hart.

II. SUB-ORDER AMBLYCERA.

FAMILY LIOTHEIDÆ.

Genus Colpocephalum.

13. *C. subpachygaster*, Piaget. (*a*) 2 females, 1 immature, Barn Owl, *S. flammea*, L., Strathord, 12th May, 1911. G. Hart. (*b*) 3 males, 5 females, 2 immature, Tawny Owl, *S. aluco*, L., Crieff, 11th November, 1910. G. Hart.

Genus Menopon.

14. *M. picæ*, D. 1 female, from Magpie, *Pica rustica* (Scopoli), Strathord, 25th March, 1910. G. Hart.
15. *M. pustulosum*, N. 1 male, 1 immature (female?), from Gannet, *Sula bassana*, L., Dundee, 10th December, 1899. G. Hart.
16. *M. lutescens*, N. 1 male, 10 females, from Guillemot, *Uria troile*, L., Perthshire, 29th December, 1910. G. Hart.

Genus Trinoton.

17. *T. luridum*, N. 3 females, from Golden Eye-duck, *Anas clangula*, L., near Bristol, 7th January, 1911. G. Hart.

There have also been submitted three additional specimens of *Braule cæca*, N., which Mr. Rodger says belonged to the lot formerly reported upon. And from sheep there are six females of *Melophagus ovinus*, taken by G. Hart, Perthshire, 11th January, 1911.

NOTES ON THE ABOVE.

2. Denny's description of his *aquilinus* leaves one in some doubt as to where one should place these specimens. *D. pictus*, Giebel may be another name for this species, but his description (as quoted by Piaget) contains nothing definite.

3. The specimens agree with Giebel's account *re* occipital hairs. There is one hair at the posterior angle of the prothorax.

4. The Corvine *Docophori*, in spite of their size, are difficult to name. At present I feel confidence in identifying only the form commonly found on the raven (*Corvus corax*), of which a fair number have been sent me from various parts of Scotland. This species is distinguished by its relatively large head, which is as a rule obviously broader than long. The clypeus is truncated, the signature short, uncoloured save for a darkened strip at the anterior edge. It stops rather indefinitely before the mandibles—its termination being hard to discern. The temples are without any colouring whatever, *i.e.*, spots or marginal bands. They bear three hairs each. All over the hairs seem longer than in the forms found in the rook and crows. This is well seen in the two hairs immediately before the trabeculæ, The metathorax is slightly *pointed* over the abdomen with a colourless posterior margin, or if this is coloured (in very old specimens) there is no spot formed, but a general deepening of the tint of the dorsum takes place. The prothorax has the sides *evenly rounded.* The abdominal spots are broadly triangular and sometimes only outlined with black, but this character varies. The undivided spot on the eighth segment (female) is medianly constricted. I am convinced that all my Raven *Docophorus* material is referable to the species Denny describes as *semisignatus*. (Mon. Anopl. Brit., p. 66-67, pl. i., fig. 5). His remarks are worth quoting: "The great width of the head and colourless anterior depression," *i.e.*, the clear space occupied by the posterior end of the uncoloured signature, "are sufficient to distinguish this insect from *D. ocellatus*, to which it approaches very nearly. Dr. Brumeister records the *D. semisignatus* as parasitic on the raven, but as he does not give the specific character of that species I have no means of identifying it with Mr. Thompson's specimens; but, lest I should uselessly increase species, I have ventured to quote his synonyms." Piaget who, it should be premised, apparently never had before him Mallophaga from *Corvus corax*, treats *D. semisignatus*, N. in a confusing manner. It appears

without remark in a table for the separation of the Corvine *Docophori* (Les Pédiculines, p. 42) differing from *atratus*, N. and *ocellatus*, N. by its "very long hairs." In the Index *semisignatus* appears as a variety of *atratus*, but although a reference is given to p. 44, where *atratus* is discussed, one finds no mention there of *semisignatus*. Finally (pp. 48-49), Piaget describes a new species *D. albidus*, with which our Raven *Docophorus* entirely agrees. He confesses that at first he believed that the specimens from *Corvus scapulatus*, from which *D. albidus* was described, represented only a modification of *D. semisignatus*, N., but that on looking more attentively into Giebel (Ins. Epez., p. 80, pl. ix., figs. 9 and 14) he concluded that *semisignatus*, N., was a variety "tres rapprochée de *l'atratus* et de *l'ocellatus*." Whatever this last statement may mean, the description of *albidus*, P., exactly applies to *semisignatus*, D., of which, therefore, *albidus* would seem to be a synonym.

No more appropriate name than *semisignatus* could be given to the very distinct *Docophorus* infesting the Raven. Whether we must write *semisignatus*, D., or *semisignatus*, N., is at present uncertain. It is doubtful whether sufficient evidence has been brought forward to reduce Nitzsch's species to a variety of *atratus*, and one is inclined to believe that the decision dictated by Denny's modesty is nearer the truth, and that Piaget has redescribed an already known species.

One point in connection with Piaget's figure of *albidus* may be mentioned. The head is drawn as *longer* than *broad* (my measurements make the proportions—pl. iii., fig. 6—to be l. 54, b. 51). On the other hand in running down the species in the table, the breadth of the head is stated to be greater than the length. Again, in the detailed description, one reads, "La téte est ici sensiblement plus large que longue, très-ramassée d' apparence." This greater width of the head apparently struck Denny too, but in a series of any length it does not hold in every case. Piaget must have illustrated his species from an exceptional individual. The peculiar signature, the milk-white temples, the rounded prothorax, and metathorax from whose posterior edge the fringing hairs rise inconspicuously—not from defined clear spots—and generally the broad head, seem to be the characters of *semisignatus*, D.

6. The bilobing of the female valvule is not always pronounced in these specimens ; in some the metathorax is practically unicolorous, but the adults are very typical.

12. There are eight examples included here from the Gannet, identical with Denny's *D. bassanæ*. These seem, to the writer, to be the immature stage of *L. pullatus*, N.

13. Piaget describes the occiput as "nu," but these examples show two fine hairs in that position.

15. The male shows well the large hyaline pellicle which fills the sinus.

17. These are referable to the small globose form of *lutescens*. The measurements agree almost exactly with those given by Piaget, as may be seen below. Only the lengths are quoted. 10 = 1 mm.

Over all, barely		16½.	Piaget gives	16½.
Head,	-	·023.	,,	·025.
Thorax,	-	·039.	,,	·040.
Abdomen,		·11.	,,	·100.

The writer has again to thank Mr. Rodger for the effort he has made to secure parasites, as well as for his courtesy in supplying all available data.

ADDENDA.

Note 2.—The writer has since January, 1912, twice examined Denny's types of *aquilinus*, but cannot yet venture an opinion of the relation between this form and *pictus*, G. The Denny Collection is not, at present, in a condition for critical examination. Many of the specimens are shrivelled or mounted in such a way as to obscure important characters. It is expected, however, that in a short time the types and other important examples will be available for examination in the form of microscopic slides. This should clear up some vexed questions in synonymy.

Denny's types of *aquilinus* have, as he points out (Mon. Anopl., p. 81, Pl. II., fig. 7), a deep incision in the clypens, which, in the Perthshire specimens is slightly concave or almost flat.

Note 6.—*N. quadrilatus*, N. is distinct from the form of *Nirmus* found on *Lagopus scoticus*.

Note 12.—This point has recently been more fully dealt with by the author, *q.v.*, "On *Docophorus bassanæ*, Denny and *Lipeurus staphylinoides*, Denny," Proc. Roy. Phys. Soc. Edin., Vol. XVIII., No. 4, pp. 248-250, Jan. 1912. The specimens labelled "*L. staphylinoides*" in the Denny collection are *all* males, and apparently typical examples of *pullatus*, *N.*

October, 1912.

XIX.—*A List of Perthshire Diptera* (*Family Syrphidæ*).

By A. E. J CARTER.

(Read 12th April, 1912).

The following list of Diptera is confined to species captured by myself during the last ten years. Until I came to Blairgowrie four years ago, my collecting in Perthshire was confined to occasional holidays spent at Aberfoyle, Callander, and Comrie, with such excursions into the surrounding country as could be easily made. Aberfoyle is a very productive district, and has yielded many novelties; so, too, has Comrie. On my last visit there (when I had ten days' collecting in July, 1907), I took over 800 flies; up to now fully 235 species have been identified, including seven new to Britain.

Attention may be drawn to the following species in the list: *Paragus tibialis.*—This is supposed to have some connection with the small bees belonging to the genus *Halictus*. At Aberfoyle I found it at a sandy bank along with *Halictus smeathmanellus*, and *H. leucopus*. *Orthoneura elegans.*—The flies of this genus are rare, and it is interesting to note that our three species occur together at Blairgowrie. *Eristalis rupium.*—This rare fly, confined to mountainous districts, is widely distributed in our county, as my records show. *Criorrhina oxyacanthæ.*—My specimen of this bee-like fly appears to be the only example recorded from Scotland. *Microdon mutabilis.*—I recorded this (*Ent. Mon. Mag.*, 1903, p. 303), as new to Scotland, but I believe it has been recorded previously from the Clyde district. It is one of our rarest flies, and the larva is recorded from the nests of various species of ants.

Those species marked with an asterisk appear to be unrecorded hitherto from Perthshire.

Paragus tibialis, Fln., male, Aberfoyle, 4th July, 1903.

Pipizella flavitarsis, Mg., several specimens at Aberfoyle, June and July, 1901-04.

Pipiza noctiluca, L., female, Aberfoyle, 4th September, 1905.

Orthoneura elegans, Mg., male and female, Blairgowrie, May and June; *O. brevicornis*, Lw., male, 8th June, 1910; *O. nobilis*, Fln., male, Comrie, 9th July, 1907, male, Blairgowrie, 12th July, 1908.

Liogaster splendida, Mg., male and female, Blairgowrie, June, 1911; *L. metallina*, F., common in June and July, Aberfoyle, Blairgowrie, Comrie, etc.

Chrysogaster hirtella, Lw., common in June, and in the same localities as the last; *C. virescens*, Lw., female, Blairgowrie, 31st May, 1908; *C. solstitialis*, Fln., Aberfoyle and Blairgowrie, July and August.

Chilosia sparsa, Lw., male and female, fairly common at Blairgowrie in May and June; *C. antiqua*, Mg., common, June to August, at Aberfoyle, Blairgowrie and Comrie; *C. longula*, Ztt., in the same localities as the last, occurs in August; *C. scutellata*, Fln., female, Comrie, 8th July, 1907; *C. pulchripes*,* Lw., female, Blairgowrie, 3rd June, 1911; *C. variabilis*, Pz. a common handsome fly, Comrie, etc., in July; *C. honesta*,* Rnd., male, Comrie, 7th July, 1907; *C. illustrata*,* Harr., male, Kirkmichael, 24th July, 1909; *C. albitarsis*,* Mg., generally distributed, Comrie, etc., May to July; *C. fraterna*,* Mg., male, Aberfoyle, 6th July, 1911, female, Blairgowrie, 5th June, 1911; *C. bergenstammi*,* Beck., female, Kirkmichael, 24th July, 1909; *C. proxima*,* Zett., male. Aberfoyle, 8th July, 1903, male, Kirkmichael, 14th July, 1909.

Platychirus manicatus, Mg., June and July, Comrie, Blairgowrie, etc.; *P. discimanus*, Lw., male, Clunie, 30th April, 1910; *P. peltatus*, Mg., sometimes very common, Comrie, etc., June to August; *P. scutatus*, Mg., also common, Comrie, etc., May to September; *P. albimanus*, F., Comrie, etc., May to October; *P. scambus*, Stæg., Comrie, etc., July; *P. clypeatus*, Mg., Blairgowrie, May and June; *P. angustatus*, Ztt., Aberfoyle, July.

Pyrophœna granditarsa, Forst., male, Comrie, 25th June, 1900, female, Kirkmichael, 24th July, 1909; *P. rosarum*, F., female, Aberfoyle, 23rd August, 1906.

Melanostoma mellinum, L., and *M. scalare*, F., both common flies, Comrie, etc., May to August.

Melangyna quadrimaculata, Verr., male and female, Blairgowrie, April, 1908.

Leucozona lucorum, L., Comrie, etc., June to July.

Ischyrosyrphus glaucius, L., Comrie, etc., July and August; *I. laternarius*, Müll., females, Aberfoyle, 11th July, 1903.

Didea fasciata,* Mcq., male, Blairgowrie, 9th July, 1911; *D. intermedia*, Lw., female, Blairgowrie, 4th September, 1909.

Catabomba pyrastri, L., female, Blairgowrie, 12th June, 1908.

Syrphus albostriatus, Fln., Callander, Aberfoyle, and Kirkmichael, July and September; *S. tricinctus*, Fln., male, 23rd July, 1910, female, Kirkmichael, 20th August, 1910; *S. lunulatus*,

Mg., Aberfoyle and Blairgowrie, June to August; *S. torvus*, OS., female, Blairgowrie, 3rd August, 1908; *S. annulatus*, Ztt., female, Blairgowrie, 7th June, 1908; *S. vittiger*, Ztt., Blairgowrie and Kirkmichael in August; *S. grossulariæ*, Mg., Comrie and Blairgowrie district, July and August; *S. ribesii*, common, Comrie, etc.; *S. latifasciatus*, Mg., Blairgowrie in June; *S. corollæ*, F., common, Blairgowrie and Comrie; *S. luniger*, Mg., Comrie, etc., May to September; *S. bifasciatus*,* F., male, Blairgowrie, 9th June, 1910, female, Aberfoyle, 13th July, 1903; *S. baltcatus*, Deg., Comrie, etc., August; *S. cinctellus*, Ztt., Comrie, etc., June to August; *S. cinctus*, Fln., Comrie, etc., May to August; *S. auricollis*, Mg, Aberfoyle and Blairgowrie, July and August; *S. punctulatus*, Verr., male, Blairgowrie, 23rd May, and female 7th June, 1908; *S. umbellatarum*, F., female, Comrie, 15th July, 1907; *S. compositarum*, Verr., common, Comrie, etc., July and August; *S. lasiophthalmus*, Ztt., female, Dunkeld, 2nd May, 1910, and Stanley, 1st May, 1911; *S. arcticus*, Ztt., female, Aberfoyle, 1st July, 1903, male, Blairgowrie, 25th May, 1908.

Sphærophoria scripta, L., and *S. menthastri*, L., are both common species, Comrie, etc. I have not attempted to separate the varieties.

Baccha obscuripennis, Comrie, etc.; *B. elongata*, Blairgowrie in June.

Sphegina clunipes, Fln., Blairgowrie, June.

Ascia. podagrica, F., a common fly, Comrie, etc.

Rhingia campestris, Mg., Comrie, etc., May to July.

Volucella bombylans, L., Aberfoyle and Blairgowrie, June and July; *V. pellucens*, L., Comrie, etc., July.

Eristalis sepulchralis,* L., female, Blairgowrie, 5th June, 1911; *E. tenax*, L., Comrie, etc.; *E. intricarius*, L., Blairgowrie, May to September; *E. arbustorum*, L., Comrie, etc., June to September; *E. pertinax*, Scop, Comrie, etc., May to September; *E. rupium*, F., Aberfoyle, Comrie, and Kirkmichael, July; *E. horticola*, Deg., Comrie, etc.

Myiatropa florea, L., Aberfoyle and Comrie in July.

Helophilus pendulus, L., Comrie, etc., June to September; *H. hybridus*, Lw., male, Blairgowrie, 1st August, 1908; *H. lineatus*, F., Blairgowrie in June.

Criorrhina oxyacanthæ, Mg., female, Comrie, 9th July, 1907.

Xylota segnis, L., Comrie, etc., June to September; *X. florum*, F., male, Aberfoyle, 1st September, 1906; male, Kirkmichael, 23rd August, 1910.

Syritta pipiens, L., Comrie, etc., common in every garden.

Chrysochlamys cuprea, Scop., male, Kirkmichael, 20th August, 1910; female, Aberfoyle, 3rd July, 1901.

Arctophila mussitans, F., male and female, fairly common at Blairgowrie in September; male, Callander, 6th September, 1904; male, Aberfoyle, 23rd August, 1906.

Sericomyia borealis, Fln., Comrie, etc., in July and August; *S. lappona*, L., 2 males, Comrie, 11th July, 1907.

Chrysotoxum arcuatum, L., Aberfoyle, a few in August, 1903; several at Blairgowrie and Comrie, June to August; *C. bicicatum*, L., 2 females, Aberfoyle in July, 1901.

Microdon mutabilis, L., 3 males, Aberfoyle in July, 1903.

[This part, pp. 103-132, published December, 1912.]

XV.—*The Construction of a Sundial.*

By THOMAS M'LAREN.

(Read 12th December, 1912).

Modern methods of recording time have superseded that quaint and interesting object—the sundial; and very few nowadays give it any consideration. There is nothing more satisfying of all the things made by man than an old sundial set in a beautiful garden. In a public place this old world monitor may form an archictectural feature, but that is all. In the quiet of the garden, it not only suggests the human interest in its surroundings, but makes us contemplate upon the lesson it conveys, and feel that we ought to be better than we are.

Perhaps much of the fascination of sundials, to most of us, lies in their inscriptions. By written lines the "silent voice of Time" is granted double expression. But we will leave the poetry of the sundial, for the present, and consider only the more unusual but practical part—its construction.

This was a subject that interested very much the philosophers of old, but they had more time to give the subject than the average man of to-day. Their intricate philosophical relics we will not attempt to describe, they are so complex in construction and for practical purposes almost useless; but we might consider for a few minutes the simplest and most useful forms, viz., the horizontal and vertical dials, without entering very deeply into the theory and principles of dialling.

In constructing a sundial, the first thing to ascertain is the latitude and longitude of the place at which it is to be erected. This can be obtained, near enough for the purpose, from an Ordnance Survey Map, the latitude and longitude being marked on the margins, but it is important to know how the latitude and longitude of a place can be obtained without this reference.

Latitude is defined in geography as the distance north or south of the earth's equator measured in degrees. But to determine the position of a certain point on the earth's surface, it might be better to regard latitude as the angle between the perpendicular to the horizon of the place selected and the plane of the equator.

The elevation of the pole above the horizon is equal to this angle, so that if we obtain the elevation of the pole we have the latitude.

For example (see fig. No. 1), let A be the centre of the earth and B a point on the earth's surface. Draw a line through A, cutting the north and south poles and continue it towards the celestial pole, and at right angles to it through the centre of the earth draw a line to represent the earth's equator. Join the points A and B and continue the line to C. Draw a line at right angles to A C at B. This line B D will be a tangent with the earth and will denote the horizon at B. The angle B A E is the latitude of the place marked B on the earth's surface.

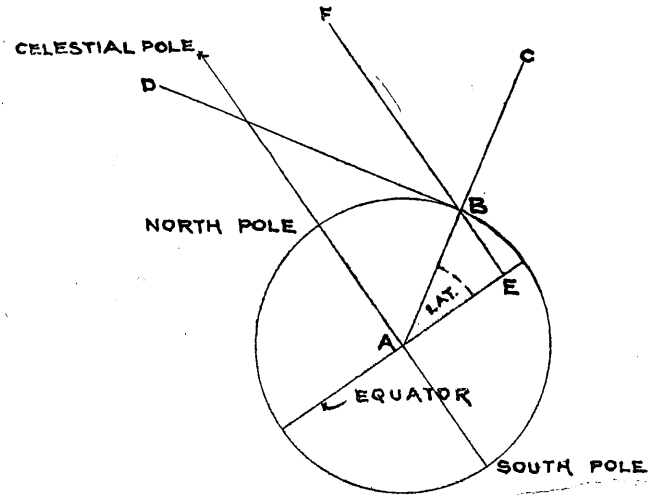


FIG. N° 1.

Owing to the enormous distance away of the fixed stars, anyone standing at the point B will see the celestial pole in the direction of a line B F, *practically parallel to the line drawn through the poles.*

Now the angle D B A is a right angle, and if the line F B is continued to E the angles D B F and E B A are together equal to another right angle. Since in the triangle A B E the angle at E is a right angle then the other two interior angles of that triangle must be together equal to another right angle.

Hence the angles D B F and A B E are equal to the angles A B E and B A E. Take away the common angle A B E and the remaining angles D B F and B A E must be equal, *i.e.*, the elevation of the pole above the horizon is equal to the latitude of the place.

The elevation of the pole can be determined by measuring the altitude of any circumpolar star (a fixed star that travels a complete circuit every day above the horizon) at its upper and lower culminations allowing for refraction, and taking the mean of these two observations.

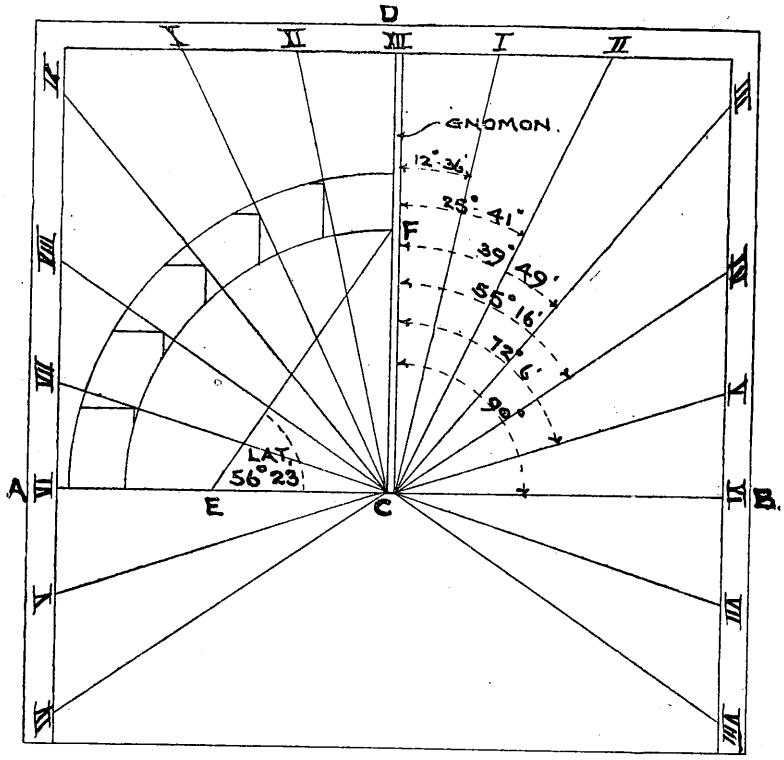


FIG. N° 2.

The latitude for Perth is 56 degrees 23′ "North." Longitude is measured 180 degrees east and west of the selected meridian of Greenwich. The earth rotates uniformly from west to east and brings the sun to the meridian of any place every 24 hours, and by dividing 360 degrees by 24 we find that the sun passes over the earth at the rate of 15 degrees per hour, or 1 degree in 4 minutes of time.

When we know, therefore, how much our noon is later than noon at Greenwich we can calculate our longitude. Local sidereal time can be obtained by observing the transit of a star, the right ascension of which is known, and then converting this into mean solar time (*i.e.*, Clock or Greenwich time). The longitude of Perth is 3 degrees 26′ west, and our noon is therefore about 14 minutes later than noon at Greenwich.

There are other methods for finding the latitude and longitude but they are chiefly marine.

Having obtained the latitude we will now consider graphically the construction of a horizontal sundial. The following method is given in "Practical Geography," Section II., published by Messrs. Macmillan & Co., Limited.

On a sheet of paper of the required size of the dial draw the line A B (see fig. No. 2). From C in the centre of A B draw the line C D at right angles. Take any point E on A C and draw E F with the angle F E C equal to the latitude which for Perth is 56 degrees 23′. With radius E F and C as centre, draw the outer quadrant shown on the figure, then with radius C F and centre C draw the inner quadrant. Divide each of the two quadrants into six equal parts. Draw lines parallel to A B through each of the points on the outer quadrant, then from corresponding points on the inner quadrant draw lines parallel to C D. Now, from the centre C draw lines through the points where these parallel lines come into contact and continue them to the edge of the plate. These are the hour lines, and can be numbered to represent the hour of the day from 6 a.m. to 12 noon. For the two hours before 6 a.m. draw two lines below A B corresponding to the first two hour-lines above it. To get the afternoon hour-lines draw in the thickness of the gnomon, fold the paper so that A C will fall on C B, and prick through to the opposite side, for the two sides of a dial are alike. If it is required to divide the hours into halves or quarters, each of the six parts into which the quadrants are divided should be subdivided into two or four parts, and the points through which to draw the lines from C obtained as before. For a small dial, however, it is sufficiently accurate to divide the angle between the hour-lines into two or four equal parts by lines from C.

Another graphic method of constructing a horizontal sundial is given by Mr. Charles E. Benham in "Knowledge," volume xxxiv., 1911. It is perhaps easier than the last. Describe a circle on a piece of paper and divide it very carefully into 24 equal parts (see fig. No. 3). At right angles to one of these radii draw a horizontal line at a tangent to the circumference, and produce the eleven nearest radii to cut this line. Continue the central line of the circle

across this line to form a letter T. Then draw two lines meeting at an angle equal to the latitude of the place and form a right-angled

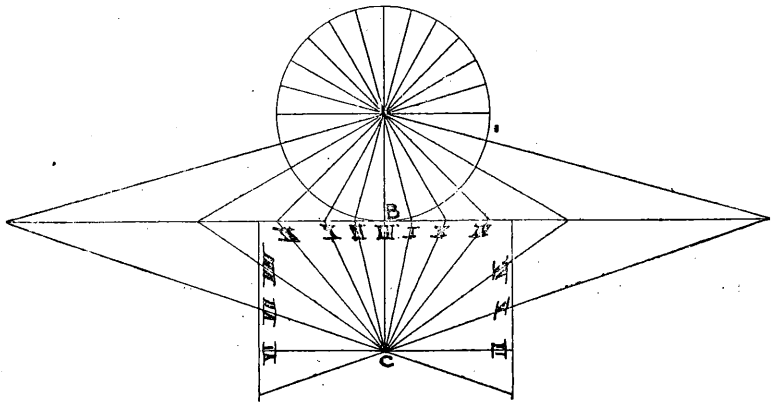


FIG. No 3.

triangle (see fig. No. 4), with this angle for its acute angle C and with the length of the side A B exactly one radius of the circle. Mark a point on the upright line of the T exactly the length of B C from the top. Draw lines through all the points on the top line of the T to this point on the other line. These will be the hour-lines of the

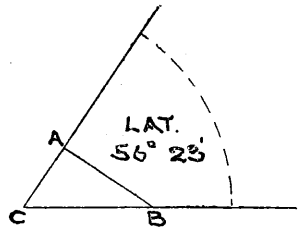


FIG. N° 4.

dial plate, and must be numbered—12 for the central one, with 11, 10, 9, and so on, in order on the left, and 1, 2, 3, and so on, in order on the right. A line parallel with the top of the T will form the hour-line for the two sixes. If half hours are required the original circle must be divided into 48 instead of 24; if quarters, 96 parts.

The gnomon must be a triangle of metal corresponding with the triangle shown on fig. No. 4, the base being B C, the point B at the head of the T, and the point C where the hour-lines intersect.

The principle is this. If you have a long needle (a) (see fig. No. 5) stuck vertically through a card disc which has been divided into 12 equal divisions it will act as a correct sundial if the whole is placed so that the needle is parallel with the axis of the earth, *i.e.*, sloped to the latitude of the place.

Now this being so it is clear that the shadows marking the respective hours (b,c,d,e,f,) would, if produced to a horizontal plane, cut that plane at b′,c′,d′,e′,f′; it follows that if the disc were removed and the needle left in the horizontal card the transferred lines would be the hour-lines on a horizontal plane corresponding with those on the sloped disc. This simple principle becomes clear on consideration, for light must travel in straight lines. The last illustration is simply a geometrical demonstration of this perspective diagram.

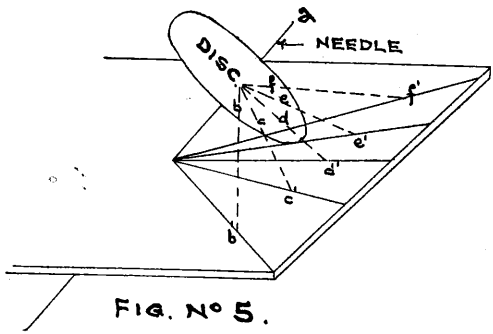


FIG. N° 5.

The whole secret of dialling is to get at the lines that coincide on the plane required, with equal divisions on a plane sloped to the co-latitude.

Both these methods give corresponding results on paper. They have been proved mathematically, and dials cut and set up as described and tested with the sun's rays found to register correctly.

Now we might consider how the above results can be obtained mathematically.

The formula for finding the angles made with the hour-lines and the meridian line of a horizontal dial is :—

L tan. hour-line = L sin. lat. + L tan. of the hour angle.

For example, to find the 11 o'clock line for Perth. The latitude is 56 degrees 23′.

L sin. lat. = 9.921
L tan. of hour angle = L tan. 15 deg. = 9.428
L tan. hour line = 9.349

Hence the angle made with the 11 o'clock or 1 o'clock hour lines with the meredian or 12 o'clock line at Perth is 12 degrees 36′.

The angles between the hour lines and the meridian for Perth worked out by this formula are as follows :—

11 o'clock and 1 o'clock	=	12 degrees	36′
10 o'clock and 2 o'clock	=	25 ,,	41′
9 o'clock and 3 o'clock	=	39 ,,	49′
8 o'clock and 4 o'clock	=	55 ,,	16′
7 o'clock and 5 o'clock	=	72 ,,	6′
6 o'clock,	=	90 ,,	

(See Fig. No. 2).

Having obtained these angles all that is necessary is to set off the hour lines with a protractor.

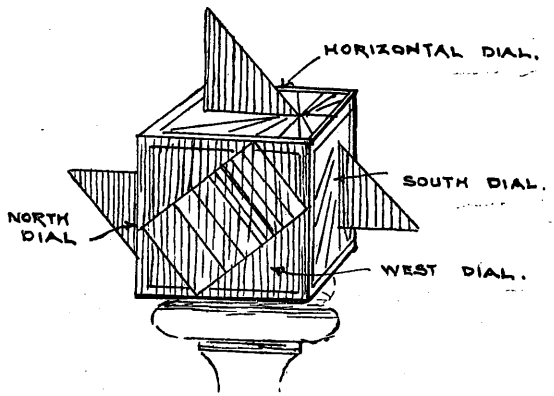


FIG. N° 6.

Vertical sundials should be made to face the cardinal points, *i.e.*, due north, south, east, or west, but if a wall does not face say exactly due west, then sometimes one side is brought further forward than the other. This does not look well, but the only alternative is to work out the problem of a more elaborate dial. The hour lines of a vertical dial are arrived at in the same way as the horizontal dial, only the gnomon is formed not to suit the latitude of the place but the complement to it, *i.e.*, the difference between the latitude of the place and 90 degrees. Thus the gnomon for a vertical dial in Perth would be set to 33 degrees 37′—the difference between 56 degrees – 23′ and 90 degrees. The hour lines are numbered back, or left to right.

The gnomon of an east vertical dial is a parallelogram in shape, placed lengthways on the six o'clock line (see Fig. No. 6).

A west vertical dial is the exact converse of an east one, and its gnomon precisely the same.

A north vertical dial marks time from 4 to 6 a.m. and from 6 to 8

p.m. only, and is therefore practically useless. The gnomon is exactly the same as the south vertical one, but placed upside down.

In reading a sundial one has to remember that it records apparent solar time. Clocks keep *mean* solar time, that is all the solar days in a year added together and divided by 365. Pope says, "Correct old time and regulate the sun." But the sun never goes wrong. It is regular in its deviations. Clock time has a constant rate throughout the year, but the apparent movement of the sun across the sky is not uniform. The varying velocity of the earth in its annual path around the sun, and the plane of that path not being parallel to the plane of the equator causes the shadow of the gnomon of a sundial to move at different rates throughout the year. The sundial records clock time only four times a year. The difference between sundial time and clock time for each intervening day of the year has been accurately calculated and can be found in Whitaker's Almanack, so that by adding or subtracting the difference, as the case may require, to the time shown on the sundial, correct clock time can be obtained. But there is another point we must remember when reading a sundial. Perth is 3 degrees 26′ by longitude west of the selected meridian of Greenwich, and as the sun travels over the earth's surface from east to west at the rate of one degree in four minutes of time, a sundial at Perth must therefore be about 14 minutes of time slower than Greenwich or clock time.

But notwithstanding these differences between the sundial and our modern timekeepers, the sundial is true to nature, and records correct time.

In setting a dial it should be placed so that the 12 o'clock line runs due north and south. This can be arrived at by the use of a large compass, or otherwise by setting the dial on a sunny day, with the aid of a clock giving the correct time, but in doing so the almanack must be consulted and due allowance made for the difference, if any, between the clock and the sun on the day the dial is fixed.

In choosing a site for a sundial it is unnecessary to say that it should be placed in a position clear of any trees or buildings that might throw shadows which would interfere with the use of the dial. Otherwise a great deal depends on circumstances and on individual taste.

It might be interesting to consider the various kinds of dials other than the two most useful ones mentioned.

Obelisk shaped sundials. This form has been suggested by the obelisks of Egypt, which are understood to have been used for astronomical purposes.

There is a well known one in Drummond Gardens, erected by the second Earl of Perth in 1630, and was designed by John Mylne (the third of the famous architects of that name). Obelisk shaped dials

have usually a square shaft, bulged capital, and tapering finial. Each side of the shaft in this type is divided generally into five horizontal spaces presenting 20 compartments. These compartments are hollowed out cup shaped, heart shaped, triangular, and other sinkings, which are generally lineated so as to mark the hours. The sharp edge of the figure casts the shadow which is especially distinct in the angular shapes and at the top of the heart sinkings where there is a certain amount of undercutting. Stone gnomons of various forms are often left in the cup hollows, and metal stiles are to be found in all the dials. Some of the spaces are often left blank, and on the north side heraldic arms, dates, initials, etc., sometimes occur. The capital is always bulged out to form an octagon with an upright facet on each of the eight sides, having a dial in each. The sloping panels on the capital facing the ground are called "Proclining Facets," and those facing the sky "Reclining Facets." The north side and the tapering finials seldom have sinkings.

Facet-headed dials are generally approaching a sphere in shape but cut so as to represent a number of facets with dials, and set on a shaft or pedestal. An example can be seen at Holyrood.

A lectern-shaped dial resembles very much a lectern or music stand. The dial stone is cut, angled and hollowed into a great many parts. The front and back present sloping surfaces, and the sides are perpendicular. A semi-cylinder is usually cut down the back slope. They are sometimes called Masonic dials, but they are astronomical and that explains their shape; the position of the sun, moon, and stars can be indicated by the time.

The first historical notice of a sundial is that of Ahaz, mentioned in the Old Testament. According to scripture it appears to have been divided into degrees, not hours, and must have been set up about 750 years B.C. Preserved in Philadelphia, United States, is a dial said to be the dial of Ahaz, which belonged to the astrologers of Assyria, and which has stirred both controversy and unbelief. Shaped like a shallow soup plate, and marvellously engraved with contemporary events, when filled or partly filled with water, the shadow, by refraction, can be "brought back" ten or more degrees at will.

Usually the invention of the sundial is associated with the name of Anaximander of Miletus, a native of Phœnicia, some 200 years after Ahaz. The first dial seen in Rome was set up on the Temple of Quirines, 293 B.C., at which period the present division of the day into hours was adopted.

In the seventh century, sundials began to be used on churches, and thence forward they were to be seen throughout Christendom in every place where men met or passed, till they were gradually superseded in modern times by clocks.

Archaeological Notes from Perthshire and Argyllshire.

By the Rev. G. A. Frank Knight, M.A., F.R.S.E.

(Read 9th January, 1913.)

(Illustrated with lantern slides).

The following paper does not profess to be more than a few "notes" of certain archaeological points of interest culled from various longer or shorter sojourns in the localities indicated. Anything more elaborate or profound I am not competent to enter into, as the time spent in the examination of each spot was limited. Yet in the course of a few short summer holidays of recent years I have found it to add greatly to the pleasure of the furlough to take some interest, even in a very cursory manner, in the antiquities of the neighbourhood: and some of these brief and imperfect studies I venture to lay before you this evening.

I.—Loch Earn and Balquhidder.

I begin with a district not far from Perth. St. Fillans is renowned for its beauty, and every year its attractions are rendering it a more popular resort. Its name is derived from Faolan, the Stammerer or the Leper, an Irish saint of the eighth century (according to Dr. Skene*), who is usually described as of "Rath Erenn in Alban," *i.e.*, the "Fort of the Earn in Scotland," or Dundurn, to distinguish him from his namesake with whom he is often confused, St. Fillan, the Abbot of Strathfillan and Strathdochart, who died about 703, nearly 200 years later. The mother of St. Fillan the Leper was St. Kentigerna, whose brother was St. Congan. The latter, along with his sister and her sons, was compelled to quit Ireland and to flee to Scotland. They settled at Lochalsh, where the labours of Congan are commemorated by a number of ecclesiastical place names. Fillan afterwards evangelized in Strathearn, his fame lingering to this day throughout the locality. St. Fillan's Chair is still shown on the summit of St. Fillan's Hill, whence the saint used to pronounce his blessings. Till about a century ago, to sit in the rocky chair and thence to be pulled out and dragged down the hill slope was reckoned an infallible cure for rheumatism. St. Fillan's Well enjoyed an equal reputation for bestowing health; while St. Fillan's Chapel was a pre-Reformation structure, whose mouldering site is still pointed out.†

* Skene, *Celtic Scotland*, ii., 33.

† Mackinlay, *The Pre-Reformation Church and Scottish Place-Names*, p. 410.

Neish Island, an artificial structure at the eastern end of Loch Earn, brings to our recollection the well-known dark tragedy of a later century—during the reign of James V. There was a hereditary feud between the Neishes of Loch Earn and the Macnabs of Killin, on Loch Tay. In the battle of Glenboltachan, to the north of St. Fillans, however, the Neishes were almost exterminated, a large stone marking the spot where the chief of the Neishes fell, his back to the boulder, and a circle of slain Macnabs around him. Stains of his blood, it is said, may still be seen on the stone. The remnant retreated to the island off St. Fillans, and retained possession of the only boat on the loch. They lived by plunder and raiding. At last vengeance overtook them. They had waylaid and robbed a servant of the Macnabs returning from Crieff. The twelve sons of the chief of the Macnabs, in the dead of night, carried a boat from Loch Tay over the mountains and down Glen Tarken, launched it on Loch Earn, crept on the island while its inhabitants were sleeping off a drunken debauch, and butchered every soul with the exception of one lad, who managed to evade their scrutiny.

Halfway along Loch Earn on the south bank there is an interesting tombstone by the roadside, bearing the inscription

"Near this spot we
re interred the bo
dies of 7 M'Donalds
of Glencoe killed
when attempting
to harry Ardvoirlich
Anno Domini 1620."

The local legend is to the effect that the Macdonalds attacked Ardvoirlich House during the absence of the Stewart men, who were with their cattle on the hills. The gallant lady of the castle, however, kept the invaders at bay till word could be conveyed to the male folk. The Stewarts then slaughtered all the Macdonalds except one, and buried their corpses in a hole on the loch side. Years later, while a drinking pond for cattle was being excavated, a number of human bones were found, and this stone was erected to commemorate the event.

There are few more beautiful prospects in Scotland than the entrance to the Braes of Balquhidder. The glen in which lie Loch Voil and Loch Doine runs due east and west, and the effects of sunshine at any hour of the day, and especially when the mountains are casting their morning or evening shadows, are marvellous. Little wonder that legend has it that St. Angus, the patron saint of the district, at a certain turn of the road near Auchleskine, was so struck with the loveliness and peacefulness of the scene that he lifted his

hands and blessed the valley and those in it. The spot is still called "Beannachadh Aonghais" (Angus' Blessing). The remains of the stone on which Angus used to sit have been built into the gable of one of the farm buildings at Easter Auchleskine, on the left-hand side of the road, going west. East and West Auchleskine are tenanted by Mr. Patrick Fergusson, whose ancestors for four generations have rented their land from the Stronvar estate. Mr. Fergusson is a keen antiquarian, and put me on the scent of a number of interesting objects. The antiquities of the Balquhidder district have been noted by Major Mackintosh Gow, F.S.A. Scot., in a paper contributed in 1886-7 to the *Proceedings of the Society of Antiquaries of Scotland*.

Through the valley in front of the farm meanders the slow, deep river Balvaig. Its sluggish current is associated in local legend with a terrible instance of tribal ferocity. In the time of one of the Alexanders (so it is said) a Maclaurin of Balquhidder, of weak intellect, was insulted by a Buchanan of Leny at the Callander fair. The "natural" retaliated with biting words. At the next fair of St. Angus the Buchanans appeared in force and attempted to take the Maclaurins by surprise. A ferocious combat ensued on the haugh land a little to the east of the present parish church. Many fell on both sides, but the Buchanans were winning the day. The chief of the Maclaurins espied a large company of the Macgregors, who had been frequenters of the fair, but who as yet had been inactive spectators of the combat. He appealed to them to strike for the honour of Balquhidder. Nothing loth, the Macgregors agreed to support their fellow glen men, on one condition, viz., that henceforth they should share with the Maclaurins the right of first entrance to the parish church. There was no time for haggling, and the Maclaurins agreed to the terms. The Macgregors rushed to the attack, and the Buchanans were hopelessly routed. They were pushed back into a bend of the Balvaig where there is a deep, dark pool. Here they perished in scores, their corpses actually damming back the current of the stream. The pool is still called the "Linn na Seichachan" (the "Linn of the Hides"). Only two Buchanans escaped the slaughter. One ran along the side of the river, but after a race of a mile was cut down at a spot still marked by a cairn. The other had got the length of the entrance to the glen leading to Strathyre, when he too was overtaken, and the scene of his death s still known as "Stron Leny" (the "Leny Man's Point").

Below the parish manse is a prominent monolith standing about $4\frac{1}{2}$ feet above ground, quite flat on the top. It is thus described by Major Gow: "It is shaped like a wedge, with the edge to the east, and is famous in Balquhidder as the place where trials of strength

took place. A large round water-worn boulder, named, after the district, "Puderag," and weighing between two and three hundredweight, was the testing stone, which had to be lifted and placed on the top of the standing stone. There used to be a step about 18 inches from the top, on the east side of the stone, on which the lifting stone rested in its progress to the top. This step or ledge was broken off about 30 years ago, as told to me by the person who actually did it, and the breadth of the stone was thereby reduced about 8 inches. This particular mode of developing and testing the strength of the young men of the district has now fallen into disuse, and the lifting-stone game is a thing of the past. A former minister of the parish pronounced it a dangerous pastime. Many persons were permanently injured by their efforts to raise the stone, and it is said that he caused it to be thrown into the river, but others said it was built into the manse dyke, where it still remains."*

Still further to the west "there are seven stones remaining of a circle which appears to have been about 30 feet in diameter—only one stone is in its original upright position, bnt there are fragments of others lying about; as usual, they are known as 'Clachan-Aoraidh,' or worshipping stones" †

The present Parish Church of Balquhidder is the third structure in which the natives of the glen have worshipped. In the first the gruesome scene took place in the year of James VI.'s marriage, when the head of the murdered Drummond-Earnoch was placed on the altar, and the Macgregors, one by one, passed by, touched the gory trophy, and swore to stand by the guilty Macdonalds, who had slaughtered their enemy, and rendered insane the wife of the chief at Ardvoirlich by displaying the head of her brother on the dining table in the castle.‡ The second structure is now a venerable ivy-covered ruin, on the floor of which lies the stone which is said to cover St. Angus' grave. The third modern building stands a little to the north.

Outside the ruin are the graves of Rob Roy, his wife, and son, visited by hundreds every year.

But in the same churchyard there are some other graves, whose stones I must refer to, for they illustrate certain traits in human nature which certainly are rare. On the south side of the ruin stands a mouldering stone with the following extraordinary fulmination on it, turning a funereal inscription, not easily read, into a wild etymological polemic:—

* *Proc. Soc. Antiq. Scot.*, Vol. XXI., 1886-87, p. 84.

† *Ibid*, p. 83.

‡ The story is well told in Fittis' *Curious Episodes in Scottish History*, p. 130-137.

"Sacred to the memory of Mr. John MACLAURIN of Lecuscridan,
the
son of Duncan, son of Finlay, son of Donull MACLABHRAINN
of Auchleskine
who departed this life the 20th Dec. 1788, aged 41,
and of his spouse
Janet Macgregor, daughter of Mr. Hugh, the son of Duncan,
son of
John Macgregor, of Auchtowmore (all in this parish
of Balquhidder)
who died in Oct. 1797, aged 50, whose mortal remains,
with those of Janet,
Robert, Margaret, Christian and Catherine, five of their children
who died in infancy, together with the remains of many of
their kindred, the Auchleskine branch of the
ancient clan Labhrainn
or the children of Laurin, are deposited near this spot; in memory
also of Duncan Maclaurin, of Lombard Street,
London, gentleman,
eldest son of the above John Maclaurin and Janet Macgregor
who died at Walthamstow near London, the 21st Nov. 1823, aged 58
beloved by his family and greatly respected by all who knew him
and WHERE a handsome monument to perpetuate his memory
has been raised over the vault containing his mortal remains.
This ancient patronymick, evidently derived from the Dalriadic
chief Laurin
of Laurin in Argyle, whose descendants and kindred
at an early period of
our Scottish history were numerous and powerful in the
districts of Monteith
Lennox, Strathern, and Balquhidder, has of late, by
Scoto-Saxon transcribers
(ignorant alike of Gaelic orthography and its proper pronunciation)
been
corrupted to Maclaren and Maclarin, and thus by the mere omission
of the single vowel *u*, equivalent to *bh* in the Gaelic, found
in the original
spelling of the proper name, the identity of this modern
name with the
ancient and euphonick name of Maclaurin is almost entirely
destroyed! To the
mere Gael this modern corruption of an old clan name is
entirely unknown
whereas the proper name is well known, and never pronounced
otherwise in
the Gaelic than 'MacLabhrain' and in English 'Maclaurin.'"

If the execution of this monument was paid by the wording on it, how fortunate must the stone mason have been! It would be well if all bearing the name of Maclaren would walk humbly to this tomb, and there learn how to spell and pronounce their names aright!

But next to this egregious tombstone is another, not erect, but lying flat on the ground. It has two faces and an end piece. On one of the faces we read :—

"In Memoriam
the clan Laurin, anciently the Allodian inhabitants of
Balquhidder and Strathearn, the chief of whom, in the decrepitude of
old age, together with his aged and infirm adherents,
their wives and children, the widows of their departed kindred
all were destroyed in the silent midnight hour by fire and sword
by the hands of a banditti of incendiarists from Glendochart,
A.D. 1558."

The other side of the same slab bears the words :—

"Erected by Daniel Maclaurin Esquire,
of St. John's Wood, London
author of a Short history of his own Clan
and for the use of his clansmen only
October 1868."

While the end of the slab has on it :—

"Daniel Maclaurin Esqr.
died 11th June, 1877,
in his 90th year
Buried at Walthamstow."

It is a singular and refreshing commentary to find, next to those pompous phillipics against the mis-spelling of the name Maclaurin, another humble headstone bearing these words, so different in their tone :—

"In memory
of
Peter Maclaren
an honest man
Died 5th Oct.
1860
aged 80 years."

To the north of the clachan of Balquhidder runs the Kirkton Glen. Major Gow refers to some curious embankments far up this glen which he investigated, locally known as "The Trenches," and credited by tradition with being the scene of a great clan battle. I accordingly twice visited the spot—the first time by a walk along the flank of the hill, so as to come on the trenches on their own level; the second time by a walk up the banks of the burn at the foot of the glen, until I could climb straight up and come upon the trenches from below. The second route, though more fatiguing, is the better one, inasmuch as one is able to judge thereby the absolute invisibility of the fortifications from below. It is utterly impossible to discern

the ramparts from the level of the burn. Nor even in climbing the hill straight up to them is there the slightest indication that one is approaching a series of gigantic earthworks. These trenches are formed on the western side of Ben Scallaidh at a height of about 2,000 feet above the sea, and fully two-thirds of the way up the Kirkton Glen. From them a noble view can be enjoyed of the eastern end of Loch Voil, Ben Ledi, Craigmore, and Glen Buckie. From the lowest to the highest I counted in all eight lines of fortifications.

(1) The lowest rampart has at its southern end a spring which gushes forth from the face of the hill with considerable volume of water. The rampart is low, and has been much intersected by runnels of water which have cut into it every here and there. It runs level along the mountain side, northwards, for 480 feet; thereafter its features become less and less conspicuous for other 216 feet, till after a total length of 696 feet it stops at a small water course.

(2) 165 feet further up the hill is the second rampart, but it is far from imposing, being a mere slight embankment sloping down from S. to N., and giving one the impression that it is just an old drainage ditch flanked by a low and now ruined dyke. Its length is only about 54 feet.

(3) Another 165 feet higher up the mountain, which is here very steep, is the third rampart, built in a curve. The ditch behind it is much deeper than (2), but the rampart itself is not so high nor so broad as (1). The trench, however, shallow as it is, could shelter hundreds of men, who would be entirely screened from the view of any one climbing the hill.

(4) Still another stiff climb of 132 feet, and slightly to the N., is a fourth rampart, shorter than the rest, built of earth and stones, though here and there the natural rock has been utilised. It is from 90 to 120 feet long, but as it tapers away into the moor at both ends, it is difficult to estimate its original length. It is not so high as (3), and more dilapidated.

(5) Another 100 feet higher, and a little to the south, is one of the finest of the ramparts. The ditch varies from 7 to 20 feet in depth, and could accommodate an entire regiment. The top of the embankment is almost flat, and so broad that, as Major Gow says, "a carriage and pair could be driven along it; it is quite level and straight along its whole length, and looks like an unused railway embankment." The view from its summit, up and down the valley, is magnificent, Ben More and Ben A'an being now visible, appearing over the tops of the hills that flank the Kirkton Glen on the west. In close proximity to the southern end of the rampart an extensive landslip of rocks has taken place, and this forms a natural fortification on the flank, being in places quite precipitous.

(6) Still another 132 feet higher up is the longest of all the ramparts, not quite so level on the top as (5), but with a broader summit, and a still more extended length. I traced it for about 650 feet. The trench behind is deep and capacious.

(7) Another 76 feet of an ascent and a seventh rampart is discernible, but very broken and ill defined. It is smaller, lower, shorter than (6) or (5), but contains a deep hole or cave between two large rocks, capable perhaps of being held by some desperate men as a last resort. In the cave I found some old stag's antlers.

(8) Ten feet higher is another and a final rampart, the natural rock features of the hill being more utilised than in the other ramparts lower down which are mostly made up of stones and earth. The ditch here is from 6 to 8 feet, but the length is not great.

Such are these remarkable fortifications on this lonely hillside. They certainly reveal enormous labour and no small skill in construction. Who their builders were we have no clue, though the Picts are credited with the work of their erection. In some respects they present features resembling the well-known pre-historic forts of Peebleshire which have been so admirably worked out and elucidated by Dr. David Christison.* But it is greatly to be desired that some skilled archæologist who, preferably, is also a trained military strategist, should make a thorough study of remains so extensive and extraordinary, and yet as far as I can see, still so imperfectly known.

The road up the side of Loch Voil reveals glimpses of exquisite beauty at every turn. At the eastern end of the loch, opposite Stronvar Castle, is an artificial island, smaller than that on Loch Earn, and similar in many respects to the one at Kenmore on Loch Tay. Beautiful plantations line both sides of the loch, and some splendid Norfolk Island pines are to be seen. The road at first runs far up the hill side, along the celebrated Braes of Balquhidder. About 1,250 feet above Tulloch Farm, there is a cave associated with the escapes of King Robert the Bruce, but I had never opportunity to visit it. After Tulloch, the road descends steeply to the lochside through a beautiful young oak and birch forest; and at Ledcreich it begins to run along the waterside for the next two miles to the head of the loch.

Ledcreich Farm is situated at the mouth of a glen which debouches from the Braes of Balquhidder. It is known as Glen Crotha, and in it are some remarkably tall waterfalls. The detritus of the burn has formed a delta, which advances a full third of the way across the loch, and thereby some beautiful little bays are formed. Looking back towards the Stronvar woods the scene is very beautiful and calm, the hills on the south side seamed by innumerable watercourses.

* *Proc. Soc. Antiq. Scot.* XXI. (1886-87), p. 13 *f.*

On the opposite side lies a "balloch," densely planted with trees, which leads over into Glen Fathan.

Beyond Craigruie, a charming little mansion house, the hills on the north side become exceedingly broken and craggy. About 1,000 feet above the loch there has been a great land slip, and some large caves have been formed. One especially is famous as the hiding-place of King Robert the Bruce during the days of his outlawry. It is difficult to find, being quite invisible from below. After half an hour's hard climbing I reached it, and found the cave dry and airy, in fact draughty. But nothing of the slightest antiquarian interest could I discover; nor were there any relics.

From Craigruie, looking east, the view is very beautiful, the burn behind the house having formed a delta which juts out into the loch. The promontory of Ledcreich is very conspicuous.

The south side of the loch from Stronvar to Muirlaggan Farm is charmingly wooded; but, beyond that, the banks are mostly bare. The road ceases, and only a rough footpath remains; but the scenery all the way is very delightful.

After passing Craigruie, one comes in sight of the head of Loch Voil, and there are many lovely peeps to be had. A little further on at Rhuvaig there is a large rock in the loch close to the shore with heather on its summit. Tradition has it that King Robert was once hard pressed by his foes and leaped on to the rock. There he successfully defended himself and slew the whole six of his assailants.

Along the loch side in this neighbourhood are remains of ancient iron works. Close to the road at different spots are slag heaps now covered with a thick top soil of turf and heather and bracken, and surmounted with oak and beech trees, 12-20 feet in height. Where the mounds have been cut into to make the roadway, handfuls of slag may still be lifted out. It shows that the ancient forest here must have been largely cut down and used for the smelting of iron.

At Monachylemore Loch Voil terminates, and in the glen beyond lies the much smaller and less wooded Loch Doine. The hills here are barer, steeper, and more green with grass in place of heather. The mountains rise to heights varying from 2,000 to 3,000 feet, and the scenery becomes increasingly grand the further up the glen one penetrates.

At the west end of Loch Doine there stands a very lonely burial-ground. It has a wall on its four sides, about 7 feet high on its south side, lower on the others: on the north side it is greatly broken down, and indeed the place is in ruins. The walls are only 30 ft. 10 in. square. Four broken ornamental stones decorate the top of each corner. I had been told that in this burial-ground there

were two grave-stones, one wholly illegible, the other in Gaelic which no one could make out. I was asked by a native of the glen to photograph the Gaelic one, in order that perhaps the camera might assist in its interpretation. I climbed up to the top of the ruined wall, which is three feet in thickness, and with some difficulty obtained a photograph of the stone, which is large and flat, 6 ft. 2 in. long by 2 ft. 1 in. broad and 1 ft. 2 in. in height, resting on two low uprights. Then I sat down on the stone, and though I am ignorant of Gaelic I began to look critically at it. In a few minutes I imagined I could make out some English words, and after some further time I was convinced that it was certainly not Gaelic, but some form of extraordinarily corrupt Saxon. Copying "Old Mortality," I scraped away the moss with my knife, cleared off the nettles and tall grass, looked at the lettering from every angle of light, and after fully an hour and a half I came off victor. The words were innocent of punctuation marks: they ran into each other: they were divided at the end of the line in the most extraordinary way: they were full of contractions: and the whole inscription reminded me of a saying by Dr. Gray Graham in his work, *Social Life in Scotland in the Eighteenth Century*, that "the gentry of that period wrote with difficulty and spelled by chance." The stone when finally conquered gave me the following information:—"1777. Here lies John Mcgregor of Glencarnaig, who died 18 Sept. 1744, aged 70 years. A man in high esteem for all virtue. He built this chapel for himself, and family, and spouse Cath. Campb[el]l, dug [daughter] to H. Campbell of Lix, and of Beat[rice] Camp[bell], daug[hter] to Arch. Camp[bell] of Torry, son to Dunstaffnage, by Janet Buch[anan], sole heiris [heiress] of Lenny [Leny], and niece to ye first Earl of Louden; she died 14th May, 1774, aged 92 years, a woman of excellent virtue." At the head there is a circular inscription with the words "EIN DOE AND SPRE NOT," or "In, do, and spare not!" which I understand is the motto of the Clan Macgregor.

I am not aware that this old tombstone has previously been deciphered: in any case, when I communicated what I had read upon it, the facts seemed to be quite new to even the oldest residenters in the parish.

At Inverlochlarig, still further up the glen, stood the house of Rob Roy Macgregor. Part of its ancient walls are built into the bothy for the shepherds belonging to the farmhouse. As one stood here, with the roar of water on every side, as the foaming cataracts converge from three glens—the Inverlochlarig Glen from the north, the River Lochlarig from the west, and the Allt Sgionie from the south—and as one watched the mists creeping along the summits of the great masses of mountains that guard this lonely spot, one could

not help feeling how in the wild times of past centuries, the law, though proverbially possessed of a long arm, might well be defied for many years by the daring spirits that inhabited these fastnesses. And indeed, a mile or so beyond the farm, the field is still pointed out, and a cairn of stones marks the spot, where Rob Oig, son of Rob Roy, on 4th March 1736, deliberately shot in cold blood John Maclaren, tenant of Invernenty farm, while he was ploughing. After a life of villainy, it was not till 1754 that the miscreant ended his days on the gallows, but not for that murder of his neighbour in the glen.

The silence in the glen beyond Rob Roy's old house is profound. There is not a single house from here till Loch Lomond is reached. Yet not so long ago it used to be said that the minister of Balquhidder had as many parishioners west of Loch Doine as he had to the east. There were till recently no fewer than two schools and three grain mills where now there are no human beings and nought but sheep and deer. Yet the ground along the riverside must still be cultivable. It is less than 500 feet above the sea: there are many broad and level plains, though the neighbouring hills are high, and one can still trace the outline of old dykes and the remains of former arable ground. Afforestation might here be attempted, I should think, with the happiest results.

II.—Kenmore and Fortingall.

As one approaches Kenmore from Aberfeldy, at Croft Morag there are the remains of what must once have been a truly magnificent stone circle. The stone masses are close to the road, being situated in a field only fifty yards to the south. They have been well described by Mr. Alexander Hutcheson, F.S.A., architect, Broughty Ferry,* whose account of them in minute detail is very interesting. "The circles are concentric, three in number, and occupy a little plateau which may be artificial, as the outer circle just covers it." The inner circle has eight stones, all standing, with one exception. The second circle has thirteen much larger stones, nine of which are still erect. The third or outer circle is made up of smaller stones arranged to form a kind of rampart. They are not erect, but laid flatwise with their longer axes in the line of the rampart. The circle measures, according to Mr. Hutcheson—

Inner circle,	W. to E.,	25 ft. 6 in.;	N. to S.,	22 ft. 6 in.
Second ,,	,,	40 ft.	,,	41 ft. 3 in.
Outer ,,	,,	58 ft.	,,	58 ft.

* *Proc. Soc. Antiq. Scot.* (1889), XXIII., p. 356.

At the south-west side and in the line of the outer circle lies a cup-marked stone, 6 ft. 6 in. long by 2 ft. broad, bearing on its surface twenty-three cups. The stones vary in height from 3 ft. to 7 ft. above ground, while some of the fallen stones measure 9 ft. 6 in. The photograph I show will give some idea of the size of the blocks.

Coming down to Kenmore past Taymouth Castle, the little artificial island is visible, lying close to the southern side of Loch Tay. It is quite of modern date. But opposite, on the northern side, is an island of much greater antiquity, known as Sybilla's Isle. The name is derived from the queen of Alexander I. of Scotland, daughter of Henry I. of England, who died and was buried here in 1122 A.D. The bereaved monarch built a priory on the island in memory of his queen, and placed it under the ecclesiastical supervision of the monks of Scone. It flourished for several hundred years, till being turned into a nunnery its abuses became so notorious that it was converted to secular purposes. Later it became a castle of the Campbells of Glenorchy, and at one time underwent a siege by the great Marquis of Montrose.

The ornate gateway into the grounds of Taymouth Castle is well known. Close beside are the Public Library and Reading Room, and on the opposite side the estate offices. The view from the bridge over the Tay as it slips out of the loch and meanders past the castle policies is particularly beautiful.

From Fearnan on Loch Tay to Fortingall is no great distance, and one is at once in a new region of interest. Immediately after passing the bridge one comes to a large field of waste undulating mounds covered with coarse grass, marking the site of a Roman camp, which the outposts of the Roman army of Septimius Severus constructed A.D. 208.* The site is not well marked, and it is now difficult to trace the line of the vallum and other defences. Several times I explored it, but did not dig, and my search ended in failure so far as any antiquities were concerned.

A little beyond, in the village of Fortingall, is the Parish Church, and next to it the celebrated yew tree under which it is said Pontius Pilate played when a little boy. Dr. Macmillan † states that it is "one of the oldest yew trees in the kingdom. In the time of Pennant, about 1772, when its trunk was entire, it measured 56 ft. in circumference. But since then it decayed completely in the centre, leaving only some bleached fragments at the corner of the enclosure. Yet from one of these separate ribs vigorous shoots have sprung up, which are covered with dark green foliage, as fresh and luxuriant as in its early prime, filling the whole place with its dense growth. The tree

* Skene, "Celtic Scotland," i. 88.

† "The Highland Tay," p. 72.

is said to be 2,600 years old; and Sir Robert Christison, counting its rings, and considering the slow growth of this species of tree, came to the conclusion that it could not be much short of that age. But Dr. John Lowe . . . thinks this age greatly exaggerated, and believes that its trunk attained its vast dimensions by a composite mode of growth, through a coalescence of distinct shoots springing from its own base . . . In all likelihood the Fortingal yew is a relic of the Nature worship of the pre-Christian inhabitants of the locality. The tree being an evergreen was considered typical of human immortality, and the rejuvenescence so peculiar to it would be a symbol of the resurrection."

The entrance to Glen Lyon is remarkable for its narrowness, and the glen itself, one of the longest in Scotland, is conspicuous for its beauty and romance. At the mouth of the glen the river Lyon foams down a narrow pass and expands a little when it emerges on the plain. At Culdaremore it turns round in a half circle, close in at the base of Beinn Dearg. In time of flood the pool at the Salmon Ladders is a sight worth seeing. After the entrance pass is penetrated, the glen opens up in a series of most exquisite turnings and twistings; never have I seen in fact a glen of such varied scenery throughout its 30 mile length. Not far from Chesthill is an ancient Roman bridge, still capable of being used—another indication of the systematic manner in which the legions of Severus sought to open up and to subdue the savage country. Occasionally the glen narrows to a veritable gorge, and again it opens out into broad fertile plains flanked with mountains over 3,000 feet in height, and beautiful to the last degree. It is an artist's paradise from end to end; but perhaps the most lovely of all the reaches in the glen is that at Innerwick and the Bridge of Balgie. It was down this glen from the west that we may trace one of the main roads by which Christianity penetrated to the heart of Scotland from Iona. The glen from end to end is rich in ancient ecclesiastical remains—churches and chapels dedicated to many Columban saints. There is a great field here for some antiquary to work—to write the history of Christianity in Scotland associated with Glen Lyon.

III.—Achnacloich.

On the way to Oban the train stops at the tiny station of Achna-cloich on Loch Etive. It is one of the loveliest resting-places in Scotland. The quiet inland sea-loch was evidently early chosen as a place of residence by missionaries from Ireland. On the shore opposite are the remains of Baile Mhodan, St. Modan's village, containing relics of his oratory and St. Modan's Well. He was a saint who crossed from Erin in the 8th century, and whose name lingers

wherever he penetrated with the gospel. His route of evangelisation has been traced out by Principal Story.* He seems first to have settled on Loch Etive side, then to have gone to Appin and Morven. Returning to Loch Etive, he crossed over by Taynuilt to Loch Awe over by Cladich to Inveraray and Loch Fyne, and from there via Strachur to Loch Riddon, where still there is the ruined church of Kilmodan. Thence he passed to Rosneath, the church of which is associated with his labours. His name is found perhaps in St. Medan's, in the parish of Airlie; possibly also in St. Maddan's chapel at Freswick in Caithness, and in Auchmeddan and Pitmeddan in Aberdeenshire. There is also a St. Meddan at Troon in Ayrshire. His old church at Loch Etive measures 57 ft. by 22½, and has only three windows, flat topped, and placed one on each end and the third on the south side.† He is always associated with St. Ronan, a companion of his in travel, whose name lingers in connection with a chapel on the southern side of the loch, at Kilmaronag. All through the Hebrides we find chapels to his memory, on various Rona's, or Ronag's. He died as Abbot of Kingarth in Bute in 737.

Near to St. Modan's Chapel was built the Priory of Ardchattan, called after St. Cattan, whose name is perpetuated in Kilchattan Bay in Bute. The ruins are picturesque, embosomed in ancient trees. The priory was founded in 1230 by the monks of Vallis-caulium, and must have been a spot of singular beauty. It is delightful to roam about in the cool shade of the great trees, and read the old Latin tombstones. Many of the stones have singular effigies carved on them of knights in armour and sainted dignitaries of the Church. One has an inscription showing that the figure represents the Prior Somerled Macdougall, who died in 1500. Another shows that it was the family burying-ground, and that two sons were successively priors. King Robert the Bruce is said once to have held a Parliament here, though perhaps the modern connotation of the word conveys too lofty an idea.

In the bay west of Achnacloich lies Abbot Island, with some fine old trees upon it. The buildings here are said once to have belonged to the monks of Inchaffray, near Crieff. Scarcely any remains are to be found now; but it is a charming island on which to have a picnic, and in the olden time it must have been a spot of rare beauty.

IV.—Colonsay and Oransay.

The island of Colonsay, with its adjacent island of Oransay, will be the next locality to which I make reference. Colonsay is one of

* *St. Modan of Rosneath.*

† Cosmo Innes, *Orig. Paroch. Scot.*, ii. 148.

the most delightful and romantic islands on the west coast, and a stay upon it yields most charming reminiscences. The steamer from Glasgow or Oban calls in at the one landing-place, Scalasaig, and boats go off to meet the arrivals. The little harbour is practically dry at low water. The coast line is very much indented, and numerous bays and inlets afford delightful surprises of rocky and sandy scenery. The antiquities of the islands have been fully dealt with in a very comprehensive paper by Mr. William Stevenson, contributed in 1880 to the Proceedings of the Society of Antiquaries of Scotland,* from which I shall make some extracts.

One of the most remarkable features of Colonsay is the great number of duns or hill forts which crown the summits of nearly every elevation. There is no high mountain in the island, the highest peak being merely 445 feet above the sea: and yet from the shore line the long ridge which stretches across the island from north-east to south-west looks very imposing and massive. The most conspicuous of these ancient hill forts is Dun Abhing, or Dun Edwin, about a mile west of Scalasaig harbour. "It is circular, and measures about 90 ft. in diameter. From it an almost unbroken view of the sea can be had all round the island. Many hundred tons of debris lie at the bottom of the rock on which the fort stands. The site, though not one of the highest hills, is well chosen for defence, and would be almost inaccessible, except on one side, where the entrance to the fort seems to have been."

"South of Dun Abhing about half a mile, and on the right hand of the road going towards Oransay, is Cnoc-an-Ardrighi, so called from a cattle enclosure which long stood near. It is situated on a low hill, very inaccessible, and would be easy of defence. It measures 55-60 ft. in diameter, and is circular. Many of the stones were removed some years ago for dyke building. When the stones were being taken down an enclosed chamber was discovered. A large quantity of debris lies at the bottom of the rock."

A great lumbering mass further to the south on the way to Oransay is Dun Cholla. It crowns a hill, and measures about 60 by 25 yards. It is sadly dilapidated and greatly broken down, but its imposing bulk in the evening light gives one an impression still of vastness and strength.

"On the hill furthest to the south-east of Colonsay is Dun Mara. It has been circular, but now only half of it remains. The rock is soft, and, in consequence of a large fall, part of the fort has disappeared. The entrance to the fort is better seen here than in any remaining one, and goes through a wall 10 ft. thick. On a favourable day there can be seen from this island Ireland, Islay, Jura, Scarba,

* *Proc. Soc. Antiq. Scot.*, Vol. XV., 1880-81, p. 113.

Mull, Iona, Tiree, Coll, Dhu Heartach"; and on Colonsay itself most of the other duns.

Proceeding along the southern shore there are similar duns, *e.g.*, Dunan-na-Figan, Garvald's Dun, and Dunan nan Nighean. Then as we commence to go northward, up the western or Atlantic seaboard, the great headland of Dun Gallon is seen from the promontory of Ardskinnish. Dun Gallon crowns a grand rock which juts out into the Atlantic, and surveys a wide stretch of ocean. There has been a lamentable destruction of the fort, for a great proportion of it has been hurled down to the base of the hill. But "it seems to have been circular, and may have measured about 100 feet in diameter. The rock is surrounded on nearly three sides at high water, and even on the calmest days the waves break there with great force." There is nothing between you and America but 2,000 miles of tossing sea. The view from the summit is very extensive; and the waters beneath being crowded with shoals, while the sides of the hill are precipitous, Dun Gallon must have been a strong and well-nigh unapproachable fort. Facing inland, there stretches a great raised beach of coarse gravel and stones, which shows that at one time Dun Gallon must have been an island. Still further north are Dunan-ga-gaoth, measuring 40 ft. in diameter; and then, back on the central ridge, we find another, towering over Kilchattan graveyard, named Dun Meadhonach, or Middle Dun. "It is an isolated rock, very inaccessible, and measures 20 by 10 paces. Then come Dunan-a-Chullich, or Boar's Dun; Dun Challiach, on an isolated rock jutting out towards the sea; and Dun Tealtaig, which embraces a cluster of circular houses or enclosures from 12 ft. to 22 ft. each in diameter.

We now arrive at Kiloran Bay, one of the most lovely inlets I have ever seen. Never was there purer sand nor a shore line more innocent of what is defiling and obnoxious. At the north-east extremity of the bay is a high elevation, Carnan Eoin, 470 ft. in height, on which is another rude fortification. The summit is somewhat precipitous, and from it a magnificent view is obtainable on all sides. Especially fine is the view of Kiloran Bay and of the sea between Colonsay and Mull.

It is on the shores of Kiloran Bay that there exist caves of unusual size and of exceeding interest. The cavern on the south side of the bay is known as the New Cave. It was discovered and explored in 1880 by Mr. Symington Grieve, who wrote a detailed account of it.* Some of our party resolved to penetrate to its mysteries. We had to find our way along the foot of big crags and over very precipitous rocks, and then to clamber straight up over immense fallen boulders, leaping from one to another. Then we came to a low entrance

* *Proc. Soc. Antiq. Scot.*, 1880, Vol. XIV., p. 318.

which required considerable stooping to negotiate. The cliff towers 24 ft. above the entrance. Inside, candles are needed, for the darkness is intense. The outer cave is a vast cavity 95 ft. long, 51 ft. broad at its widest, in height 14 ft. to 15½ ft. at its highest parts. Projections of the rock at various points cast extraordinary shadows. Stalagmites are plentiful, littering the floor. A crystal spring gushes up from one of them, and must have afforded water for any inhabitant of the cave. Mr. Grieve discovered quantities of bones in the earth and stones of the cave floor: we also looked for remains of this nature, and were rewarded with the recovery of a few. Various galleries opened off this central one, and led through narrow passage-ways into caves of various dimensions, all of which we thoroughly explored. The total length of the cave, according to Mr. Grieve, is 230 ft.

Standing at the mouth of the cave, on emerging again into daylight, we saw on the opposite side of the bay two great dark slits in the rocks, which betrayed the existence of other caves. They are quite easily accessible from the sea level. The floor is of sand, and the passages run inland for several hundred feet. We diligently searched the remote recesses of the caverns for bones, and carried off some small bagfuls. The caves are marvellous in their size and length, and well repay a visit.

There is a long narrow loch named Loch Fada, running across the island from north-east to south-west, which has still on its banks stumps of large trees *in situ*, evidently the remains of an ancient forest. This is but another proof of the fact, otherwise so well authenticated, that these western islands at one time were all thickly wooded, and that their present denuded appearance is a modern feature, and does not extend far into the past. The only woods on the island to-day consist of dwarf growths of hazel, oak, and birch, the plantation round Colonsay House being entirely of recent formation.

"About three-quarters of a mile from Scalasaig there is a standing stone 8 ft. above ground, undressed, of irregular form, and 5½ ft. in girth. It forms part of a small circular structure about 12 ft. in external diameter." Another stone lies sloping at an angle of 45 degrees. What these stones commemorate is lost for ever.

"There are on Colonsay and Oransay the remains of nine old churches or ecclesiastical structures, and the sites of other three are remembered by the older natives. Ten of these are in the island of Colonsay and two in Oransay."

One of these is Teampull a Ghlinne, the Temple of the Glen, which stands on the right hand of the road leading down from the north to the crossing place to Oransay. "The building is nearly

due east and west, and measures 31 ft. by 19 ft. outside, and wall 27 in. thick. The walls are of stone and lime, and much broken down, only the back and front walls now remaining to the full height of about 8 ft. There is one small window on each side, 24 in. by 6 in." The whole structure—lonely and deserted, almost buried in bracken and brambles—was strangely melancholy. I sat on the ruined fane of this pre-Reformation chapel and tried to conjure up the scene when the dead were left lying in this building till such time as the tide suited for crossing the sands to Oransay.

Before we leave Colonsay let me refer to one more feature of antiquarian interest. High up on the face of the precipice that juts out on the south side of the island, there is a projecting rock which has attached to it the gruesome name of the "Hangman's Hole." There is a hole in this piece of rock through which a rope used to be let down. Then when the halter was securely round the neck of the criminal, he was hauled up and left dangling in the air. Not a few have, in the grim old days, met their death in this way

The strait between Colonsay and Oransay is practically dry at low water, and one can walk across: although the sense of insecurity and uncertainty as to the returning tide rather militates against the comfort and peace of one's mind. Tides in these western isles are notoriously capricious, and one must always err on the safe side and leave a good margin of time if one is to get back safely to the spot from which the departure was made. At its widest part the two islands are separated by about a mile, at the narrowest by less than quarter of a mile.

The walk round Oransay is one of the most exquisite beauty: each little sandy or rocky bay seems more lovely than its predecessor, and there is a sense of spaciousness in the uninterrupted view towards the four points of the compass. Indeed one feels all the time as if one were actually at sea.

The only inhabited house on the island is Oransay House and farm, close to which are the celebrated ruins of the Monastery of Oransay. These are fairly extensive, but all are unroofed now and in ruins. "The oldest portion seems to be that called the cloisters, being part of a wall in the inside 27 ft. long by 27 in. thick, and having five semicircular arched openings through it." In the east end of what may be called the church or chapel there is a finely formed Gothic pointed arch window with mullions dividing it into three lancet-shaped openings. The height from the sole to the point of the arch is 12 ft., and the width 5 ft. All the cheeks of doors and windows, and mullions of this apartment are of dressed freestone of a kind not found on the islands. Two and a half feet from the wall, and in front of this window, is the altar table, covered by one

large slab 6½ ft. by 3 ft. "Underneath the altar are stacked piles of skulls, thigh bones, arms and legs, brought to the surface of the ground by rats. They are collected by the farmer and stored here inside the altar. All round the wall there are propped up what must once have been stone lids of coffins—twenty-four in number. Many of them represent knights in armour, others hunting scenes with deer, horses and dogs.

Beside the monastery on the south side stands the Oransay Cross, a singularly fine piece of workmanship. The shaft measures 12 ft. 1 in., the arms from point to point 3 ft. 5½ in.; the thickness is 4⅜ in., the diameter of the circle 27 in. The breadth of the shaft at the base is 20 in., at the top 11 in. The Cross faces due east and west. The whole is exquisitely proportioned, and is one of the finest specimens of Celtic art.

On a little knoll on the east side of the church stands the Macduffie Cross, considerably mutilated. It is now only 3 ft. high, 13 in. broad, and 3 in. thick. It is, like the Oransay Cross, let down into the masonry of its pedestal and securely fixed therein. There is a figure carved on it at the top.

In close proximity is the burial-place of the Macneills of Colonsay, consisting of two enclosures on the east side of the monastery, partly outside the old structure, partly within. The floor of the mausoleum is laid, not with sand or gravel, but with myriads of the shells of *Littorina obtusata* from the neighbouring beach.

Above the farm and the ruined Augustinian monastery, which latter structure dates from the fourteenth century, stands the hill Carnan Chul-re-Erin. It was here that St. Columba stood, and gazed back to Ireland, according to the well-known story in Adamnan's "Life." As he still could see the land of his birth, he decided to go further afield, and launching his curragh again, he halted not till he had reached the southern bay of Iona. Oransay in its loneliness and solitude, in its memories of Columba and St. Oran, in its associations with pre-Reformation Scotland, in its grand architectural remains, is to my mind one of the most romantic and fascinating of the Inner Hebrides.

V.—Clachan and West Loch Tarbert.

At the mouth of West Loch Tarbert, in the peninsula of Kintyre, there rises on the southern side a conspicuous and solitary eminence. It is known as Dunskeig, and stands 469 ft. above the sea. The summit commands a very extensive view in all directions.

On the top are two forts. The north-east one stands a few feet higher than that on the south-west. The north-east fort is a mass

of stones, which rise to a height of 10-12 ft. The stones are thrown down on the outside in a ruinous heap, but inside, the stones in many places are still *in situ*, built up with regularity. There is a walk round the fort, and then a second rampart and a lower mass of thrown down stones. It is 152 paces round this walk encircling the fort. A cairn has been made on the summit of the wall of the fort on the south-west side. With a breastwork sufficiently high the fort might have resisted a long and stout attack. The hill is precipitous on the south-west side. The gateway into the fort faces north, and is 12 ft. 10 in. in length: it is made of square stones built up in large blocks. The passage-way is 4 ft. 9 in. in width. Inside, the fort is circular, built up in courses of masonry, without mortar, most of the stones being squared. Walking round the inner edge of the ruined parapet of the wall measures 66 paces. Judging by the masses of ruined stones which lie encumbering the ground, the wall must at one time have been much higher. At present its highest elevation on the inside is not more than 5-6 ft. The walls are very thick, and the stones must have been carried up the hill with great labour, some of them measuring 3 ft. by 1 ft. 10 in. by 1 ft. The interior of the fort is now a mass of nettles.

The south-west fort is separated from this one by a slight depression in which is a rocky eminence, blackened with the fire and the tar from Jubilee and Coronation bonfires, but in olden days it must have been the summit, higher than either of the two artificial forts. It may have been the place of sacrifice: certainly it was used as a watch tower and beacon fire.

The south-west fort is a vitrified one, higher on the north side than on the south by at least 6-8 ft. The paces round the circular hollow number 97. The lip of the fort is shaped like a crater, and is made up of loose stones covered with grass and vitrified into slag-like masses. The interior is grass-covered, a circular, basin-like cavity. It is said to have been employed by the Norsemen as a watch tower, and the beacon fires from its summit may have given the rocks the vitrified appearance they present to-day.

I shall now bring this lengthy paper to a close by my last slide, which illustrates a tombstone on Jura, an island which lies right opposite Clachan and Dunskeig. It runs as follows: "Mary Macgrain, died in 1856, aged 128, descendant of Killouir Macgrain, who kept a hundred and eighty Christmasses in his own house, and was born in the reign of Charles I." Jura, then, is the place to migrate to if one wishes to enjoy a long life, and with the hope that many of you may attain to similar longevity I close my remarks to-night.

XXII.—*Note of the occurrence of Phyllobius maculicornis, Germ. on Raspberry in Perthshire, May, 1912.*

By THOMAS ANDERSON, M.A., B.Sc.

Read, 9th January, 1913.

During the latter half of May, 1912, reports of the occurrence in phenomenal numbers of several species of the genus *Phyllobius* reached the Edinburgh and East of Scotland College of Agriculture from several districts, disquietude having been caused to growers and foresters by their appearance. The species reported were :—

P. maculicornis, Germ , from Perthshire and Forfarshire on Raspberry.
P. argentatus, L , from Peebles-shire on Sitka spruce.
P. pyri, L., from Argyllshire.
P. urticae, D.G., from East Lothian in hedgerows.

In the raspberry plantations at Essendy, near Blairgowrie, *P. maculicornis* appeared about the middle of May in large numbers, and its presence caused considerable anxiety to the growers there.

When the writer visited the plantations the weevils were literally covering the foliage of the canes, and when disturbed they fell, after the manner of weevils, to the ground in numbers so great that the sound of their dropping was like the sound of rain on the leaves.

The insects eat the soft tissue of the leaf between the veins, most frequently at the margin ; a damaged leaf displays an edge irregularly nibbled, and a few irregular holes eaten through from surface to surface.

The damage done in a few days to the young foliage was considerable, and had the beetles remained on the plantation long enough there is no doubt they were capable of stripping it of its leafage. The insects, however, moved before the wind, flying strongly in bright sunshine, and before the end of May their numbers had very appreciably lessened. Spraying with arsenate of lead had been recommended as a precaution, and its application was found to be effective ; the presence of the beetles was much less noticeable in the area sprayed. In the writer's opinion, so far as damage by the adult insect is concerned, treatment is unnecessary in the case of raspberries, as the insect has a short adult life, is nomadic in habit in bright weather, is small in size, and does not appear to be particularly fond of the somewhat rough raspberry foliage. Judging from the effect of its depredations on young foliage of wild cherry, the insect is probably capable of doing very considerable damage to the more glabrous and tender leaved fruit trees.

Theobald records attacks on apple, pear, plum, bramble, cherry, nuts, sloe, maple, hawthorn and oak.

Gillanders records a bad attack on mountain ash and birch in Northumberland.

At Essendy the beetles were found feeding on all kinds of soft leaved deciduous trees and shrubs in the vicinity with the sole exception of lilac. Wild cherry suffered most. (The photographs indicate the normal condition of the gean attacked, and a pronounced case of damage to raspberry).

The genus *Phyllobius* is superficially characterised by the beautiful and brilliant metallic colouring of the body. *P. maculicornis* varies from black (*var. cinereus*, Fowler.) to grey, and from a dull metallic olay colour to brown, copper, green, and golden green. It varies in size from one-fifth to one-sixth inch. The eggs are laid in the ground. The larvae are footless grubs. They pupate in spring and the beetles emerge in May.

It is interesting to record here a report of the occurrence of *P. argentatus* on Sitka spruce in Peebles-shire. Investigation, however, showed that this species was accountable for probably only a small part of the damage done to the above mentioned plantation of two years old Sitka spruce, as from 12 to 30 specimens of *Otiorynychus picipes* (Raspberry Weevil) were found in hiding in the moss below each attacked plant. Specimens of both species were enclosed in jars with undamaged shoots of the spruce, but the damage done by both was alike, the heart being gnawed out of the tassel of young leaves at the end of the young shoot. The damage was done, however, much more rapidly by *Otiorynchus*, which is twice the size of *P. argentatus*.

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XXIII.—*Yeast.*

By JOHN STEWART.

(Read February 13th, 1913.)

The micro-flora of all countries is of the greatest interest. Solitary species of it may be of the greatest assistance to man in the ordinary process of manufactures or in the preparation of food; while, on the other hand, many whole genera are our most deadly

enemies. On its countless members the fertility of the soil depends —that is, its ability to assuage the nitrogen hunger of living things. Indeed, the whole nitrogen cycle on the earth results from its activity, and the destruction of all the dead organic matter, with its reconstruction into its organic elements is brought about by the active metabolic processes of its minute organisms. The masses of cellular tissue that are shed from the forests in autumn have vanished in the course of a year under its attacks, and the products are left as simple food for the plants of the succeeding year.

Among these organisms which are of the greatest importance in the general biology of the world, probably there is no single one that man has consciously used for a longer time than that of which I should like to give a short account. The enormousness of the numbers in which all such forms as I have just mentioned occur, and the impossibility of excluding them, unless by the exercise of an artificial sterilisation of the strictest form, make them, of course, the commonest of plants. In the summer months, whenever there is fruit or saccharine matter, Yeast in some species occurs, and in the winter it is to be found in the soil of fruit gardens and vineyards, or any place where it has been used, and in its relation to man it is possibly daily in the mouth of a large proportion of the civilized world, for the remains of the yeast cell occur in all forms of wheaten bread that has been leavened. The Yeast, or genus *Saccharomyces*, is a cultivated race of plants, but as to the origin of its cultivation we can say nothing. The universality of its application by man in the preparation of his bread or wine leads to the belief that the use of it must have begun in a number of countries almost simultaneously. The Israelites brought Yeast with them from Egypt, and used it long anterior to the time they finally crossed the Jordan. In the little leaven that leavened the whole, the yeast cell flourished, and how difficult was the task set before the wanderers in the hot country by the command to rid themselves of all leaven can only be appreciated at the present day, when the more exact methods of microscopic research show the almost impossible task of absolute sterility by ordinary every-day methods.

But probably the ability of Yeast to produce alcohol from the saccharine fluid in which it lives first brought it to notice of the chemist. Of its two functions, producing carbonic acid gas and producing alcohol, the latter is doubtless the more interesting. The strange liquid substance, with its wonderful resemblance to water, both in appearance and as a chemical fact, has a world-wide production, and one can quite easily imagine how it originated in any warm country from the dropping of a single yeast cell into some saccharine

fluid, as a decoction of honey and water or fruit juice, and then a keeping of the drop of the turbid liquid to react on such a solution in the future. Such a condition is quite common in many countries at the present day. Little masses of dried fungi of various species living together are kept for fermentation purposes, such as the Kephir grains of Siberia, with the many similar substances in the southern parts of Asia, and the Ginger Beer Plant of our own country, which is a compound growth of *S. pyriformis* and *Bacteria vermiforme*. These fermentations all came by chance to some tribe first as casual occurrences and then as regularly organised domestic operations, subject to all the uncertainties and unforeseen calamities which befall the ordinary rule of thumb culinary operations, for other living organisms, of course, would arrive and set up actions which produced flavours other than those desired. Even in too concentrated a solution the ferment might refuse to work, for it is the high concentration of preserves, with the resultant high osmotic pressure, which sets up a plasmolysis in the Yeast cell and prevents its acting and spoiling the jam, and just as man began many centuries ago to grow only the finest of the cultivated plants, and to root out those of a poorer quality, so more recently he set himself to domesticate the microbe. If it is of a wicked type its malevolence is carefully cultivated out of it; it becomes docile and tractable, and is then injected into a field that might be occupied by a more virulent type and the latter excluded.

As more rigorous methods of cultivating pure races of phanerogams have been adopted within recent years, so too Yeast has been submitted to more scientific and careful methods in pure cultures. Pasteur first freed the yeast flora from all foreign vegetable growths of the bacteria group, and cultivated nothing but Yeast. But among the large number of species, as in all plant families, there are many useless or hurtful, or at least they are so when put to other uses than what they are suited for—*e.g.*, Ellipsoideus. These were eliminated by Hansen much as an apple-grower would eliminate the poorer type of fruit from his apple orchard, and particular races of Yeast were cultivated. Jorgensen has carried this a step further. Finding that the progeny of a single cell arising from the spores may show individual variation, much as we may see in other plants, and that such might give rise to difference in taste and smell and other properties—in fact, there may be as much difference as between the same children of a household—he set about raising new races from single spores till now pure cultures are employed in all commercial establishments where Yeast is used in the process of manufacture.

The mention of spores, however, marks a point where it is necessary before going further to say something of the position of the

subject in the plant world. Yeast or *Sacchoromyces* is a unicellular fungus of a usually oval shape, of immense variety, from 7 to 10 micra in breadth and length. It is enclosed in a cell wall, and is to be distinguished from other fungi both in the group to which it belongs —the Ascomycetes—and in all others by the fact that it reproduces itself by budding, and it gives alcohol as an end product in its metabolism.

The presence of a nucleus in Yeast was for a considerable time a question much debated, but is now finally settled. The nucleus is always present though difficult to see, more prominent being what are known as the metachromatic bodies that take on stain much more quickly. They are closely associated with the nucleus. Within the protoplasm are usually numerous vacuoles large or small, dependtng on the condition of the nourishment of the cell.

The cell is the ascus. There is no permanent filament as a rule, and for this reason. From time to time attempts have been made to associate the single cell with some other fungus, the conidia of several others bearing a considerable resemblance to it, but the fact must be accepted that it is a reduced form.

The whole single ascus takes part in the formation of spores, and produces from 1 to 4 spores, though these are not formed under ordinary circumstances of yeast growth. Certain conditions must exist before sporulation takes place, certain limits of temperature which must not be exceeded, and these varying for different species are also taken as criteria in deciding on the species. The cell must be a healthy, fat young one, and a suitable supply of air and moisture are necessary, and with these present, sporulation then takes place in a short time, the duration depending largely on the question of temperature. But it is by budding that the yeast naturally grows, and that method is more interesting.

A single cell of *Saccharomyces* placed in a suitable medium at an ordinary temperature immediately begins to bud. In six hours a complete bud is formed and another is on the way, and the first formed bud sends out another, and reproduction goes on in geometric procession. One naturally asks how long does this continue? Given sufficient food, the fact that one cell will produce 50 tons of yeast in about seven days is an answer as to what takes place in a commercial undertaking where yeast is produced for the market. As to the actual limits of growth I shall speak further down.

Like all plants, Yeast requires food and oxygen. To gain the requisite energy for growth it must respire, and if oxygen is present as a gas then it respires oxygen, but if that is absent then it respires the sugar of the solution on which it exists. The more vigorous the growth the greater supply of oxygen is required. Bnt it is not to

obtain supplies of the plant that cultivation goes on. The supply of the plant is a bye-product. Cultivated under conditions in which the supply of oxygen is restricted and regulated, the Yeast respires the sugar in the saccharine solution in the wort in which it grows, and the end products of the change are two well-known substances—carbonic acid and alcohol.

$$C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2.$$

As the change goes on, of course the Yeast grows vigorously, and increases at the rate spoken of, and is collected and put on the market as pressed Yeast in great quantities. In Europe about 150,000 tons of pressed Yeast are required yearly, and it is generally reported that the weekly import to the British Isles is 250 tons per week, that is in addition to the production of quantities by the great alcohol distilleries here which now specialize in such work. The whole growing and preparation of Yeast for the market requires the attention of a large staff in such a spirit manufactory, and of course if all sources of supply were utilized there would be abundance in this country without necessity of importing. A brief description of the process carried out in a modern raw grain or alcohol distillery where such immense quantities of Yeast grow may not be out of place. Immense floors are covered with thin layers of barley and rye grains, which are kept moist and allowed to sprout till the tiny young stem is visible. Growth is then stopped by heating on a floor of iron over a great fire, and the converted grain is now malt, which is ground up later. At the same time great quantities of maize or Indian corn are also ground up, and a suitable mixture of these is then made. Hot water is mixed with them and a mash made. The water extracts the malt sugars which have been produced in the grains by the liberation of diastase in the action of growth. All this, of course, goes on in immense proportions in tubs of great diameter, and in the meantime, in another part of the building, there is the chemical laboratory, where the chemist or technical mycologist is busy. There with carefully sterilized apparatus in sterile chambers a single cell is picked out and set on the way to grow, first on nutrient solution under the microscope, then in a flask which excludes all other germs, and then in a larger quantity of wort. In the wort other organisms start growth also, more especially the lactic acid microbe, which is allowed to grow, in the knowledge that after it has raised the acidity of the wort to a certain degree the toxic effects of its own activities put an end to them.

Leaving that and turning back to the mash-tun, where a hot solution of the soluble sugars has been obtained, we can now see how this is prepared for the reception of the Yeast. The liquid is rapidly cooled by passing it over a refrigerator, which at the same time

ærates it. This rapidity of cooling is requisite, for it is at this stage that wild yeasts come flashing through the air, and may cause havoc if they find a suitable temperature and a suitable saccharine solution by developing rapidly, and giving rise to tastes and smells unwanted. But if nothing of the kind happens then only the recognised yeast which is put into the mash now develops. The whole liquid begins to froth up with a creamy top as the Yeast multiplies and carbonic acid gas is given off in great quantities, another bye-product that is now being largely utilized. There are two great divisions of yeast, top and bottom.

Top fermentation is one in which the froth on the surface is often covered with a thick layer of Yeast. In bottom fermentation this layer is never thick, and is sometimes entirely absent. In typical top and bottom fermentation, this, the really only noticeable point of difference, is very prominent. Various investigators have attempted to find definite prononnced characteristics for each of these groups.

Sometimes a bottom Yeast may for a time exhibit feeble signs of top fermentation. But no typical top yeast has been transferred into a bottom Yeast or *vice versa*.

That which rises to the top as fermenting goes on is skimmed off. The bottom Yeast acts differently, the liquid is drained away, and the Yeast centrifuged off by being passed through cream separators. The Yeast is purified by passing through seives, then pressed through filter presses, and finally sent out in small bags to be used as required. In baking it is largely used in England, but the Scotch baker rather has a small yeast factory of his own. He makes up a nice mash from some malt, adds the requisite flour and water at a sufficiently high temperature, cools it down, and adds some of the previous stock he holds, and gets a rapidly fermenting liquor by the craft and mystery of barm making, which barm carries on the fermenting or the raising of the dough in his loaves.

The liquor from which the Yeast was taken (the wort) is rich in alcohol, which is of course *raison d'être* of the whole process, and without discussing the distillation, the origin of alcohol from the Yeast plant is worth considering. That a plant should produce a substance which is so poisonous as to inhibit its own growth calls for some explanation. When 6 per cent. of it is produced growth stops, and when 15 per cent. further fermentation ceases.

The higher the temperature the less the percentages within limits which cause this. There are several conditions which are of interest in this fermentation process Absence of oxygen gives a vigorous production of alcohol, but a decrease in the reproductive activity, and

vice versa. Now, it is, and has been, an interesting question as to whether the growth of the *Saccharomycetes* may go on in the complete absence of oxygen, *i.e.*, whether the fungus is an anærobic organism or not. The experiment, in proof of this is one of considerable difficulty, since *Saccharomyces* is particularly greedy of oxygen, and can obtain it from all sources, and since, at the same time, an extremely small supply fulfils all its wants, but so far I am on the side of those who say that such growth is not possible, though it has been stated otherwise; but I shall return to this at a future time.

The whole interest in *Saccharomyces* lies in the fact that it produces in enormous quantities carbon dioxide and alcohol; and, probably, to the botanist, in the fact that its own reproductive powers are very great.

The former notions of fermentation as being life without oxygen have been expanded in more recent years, and are much more complicated.

From the standpoint of œcology the alcohol produced by yeast must be regarded as a weapon formed by the *Saccharomyces* capable of hindering the growth of other fungoid competitors in the saccharine nutrient media in which it exists. The carbon dioxide is only the ordinary product of metabolism of all living organisms, but the alcohol is peculiar to this and other fungi. Yeast is a budding fungus producing alcohol.

The food of the Yeast plant is sugar, bnt not all sugars are acted on alike, some, indeed, not at all. One division of the species is made by considering the action of yeast on sugars. Yeast does not ferment the ordinary sugar, but what we commonly speak of as glucose or fruit sugar. And the whole question now to be considered leads us into the difficult path of modern chemistry, among the substances known as enzymes. The word itself literally means "in Yeast," and recently a quaint definition was given by the head of a large yeast producing establishment, who said enzyme was a substance created by Providence for a beneficial purpose, and about which we know nothing. It is a hydrolytic ferment, a compound substance of protein nature, about which we do know little. No chemical formula can be assigned to it.

The presence of an enzyme is, however, easily demonstrated. Allow a few grains of barley to grow till the root and plumule are clearly visible. Dry them to stop growth, grind up the grains, and extract with water. To the watery solution add alcohol til a grey precipitate ceases to form, and then collect the precipitate. It is an enzyme called diastase, the peculiar property of which is that it converts starch into sugar. It exists in the barley cells, and acts naturally on the germination of the plant, converting the starch of the endosperm

into the sugar necessary for the nourishment of the barley embryo Given the necessary temperature and moisture, the conversion takes place quite as well outside the cells as in them. Starch heated with a little of the diastase powder turns to sugar, as can be shown by the ordinary tests, such as iodine and Fehling's solution.

It is this enzyme which is first brought into play in the turning of barley into malt; in fact, the whole question of the malting of barley is to bring the diastatic enzyme into play.

In *Saccharomyces*, however, there are at least three enzymes present —invertase, maltase, and zymase or alcoholase. If ordinary sugar is acted on by an acid solution and heat for some time, then it changes its character and splits up into two molecules of glucose or fruit sugar, is "inverted" as the technical term is. Zymase is an endoenzyme, since it cannot be obtained until the enzyme invertase is allowed to pass through the cell wall of yeast. The action of the enzyme called invertase is similar to the acid action. Its presence in the yeast cell is easy of proof, as also is its independent action, since it acts at a temperature very much greater than that which the other enzymes act at. If, therefore, a sugar solution is raised to a high temperature. it is found that no fermentation is set up, but inversion goes on, and that change is always preliminary to fermentation, as we have already shown.

The enzyme maltase turns the malt sugar into glucose or sugar fit for food of the yeast, while the most important of all is the zymase or alcoholase, the enzyme which, acting on sugar, produces alcohol.

This paper is not a consideration of the difference between vital changes and chemical changes, so I need take no further step in that thorny path than to say that all along there has been a point in dispute here.

The older claim for what has been the most interesting, and what is still the most interesting function of yeast—namely, the production of alcohol—was, of course, that it was a vital change. Pasteur described fermentation as life without air, which, as I have already shown, is at least doubtful. According to his view the yeast deprived of air by immersion in the saccharine liquid provides itself with the necessary oxygen by breaking up the sugar molecule.

But Buchner has shown that by drying yeast, pulverising the cells, extracting the contents, and filtering free from all yeast cells, a liquid can be obtained which carries on fermentation like the living cells. This is zymase or alcoholase. The action of the enzyme is subject to much greater limitations than that which goes on within the cell, but carries out the change perfectly in a similar manner, and the question of life no longer seems to arise.

As Buchner has put it, the behaviour of yeast juice in presence of

toluene and 40 per cent. sugar solution after centrifugalising, treatment in chamberland filter, dessication, extraction of precipitate, extraction of killed permanent yeast with glycerine and water and concentration of such solution shows that there is no doubt of the fact that no living agent is present in the yeast juice. After such treatment there is little doubt that nothing vital as we understand it could exist. If it is still maintained that it is a vital action, then vital must be redefined.

The whole function of the Yeast cell physiologically is, therefore, to set free these enzymes, which, acting on some saccharine matter, change it into alcohol and carbon dioxide.

$$C_6H_{21}O_6 = 2C_2H_6O + 2CO_2.$$

·6 per cent. of succinic acid and 2·5 per cent. of glyerol are also produced. As a producer of the latter two it has not been used but for the former substances.

We have domesticated plants belonging to the Phanerogams, and now the more modern idea is (excluding the wilder forms) to tame and domesticate the microbes which are the necessary elements in the processes of manufacture of food and drink.

SYSTEM OF SACCHAROMYCETES.

RIGHT SACCHAROMYCETES.

GROUP I.—Cells form in sugar solution at first an accumulation at the bottom, and then later a film on the upper surface, which is slimy, and contains no air. Spores smooth, round oval, with one or two spore walls. Reproduction by means of budding or by a promycelium. All causing fermentation.

I. *Saccharomyces.*—Spores with one spore wall, propagation through budding. Sometimes budding cell forms a separate mycelium.

This contains most species.

II. *Zygosaccharomyces.*—As the previous, but union of cells takes place.

III. *Saccharomycodes.*—Reproduction by mycelia.

IV. *Saccharomycopsi.*—Spore with double spore wall.

SPECIES OF YEAST.

I. Those species which ferment Maltose, Dextrose, and Sucrose.

S. Cexevisiae:—Pastorianus I., II., III.

Ellipsoideus I., II.

Among the yeasts *S. Pastorianus* is distinguished by its sausage-shaped cells. It causes a disagreeable smell and a strong bitter taste

in beer. Yet it is the yeast that gives a satisfactory fermentation in wine

Pastorianus II.—Yeast cells smaller.

Pastorianus III.—Cells same shape, but different temperature limits.

Ellipsoideus I.—On surface of ripe grapes in the Vosges.

Ellipsoideus II.—Dangerous disease yeast in bottom fermentation breweries.

Vordermanni.—Present in Raggi. Consist of balls of rice, pieces of sugar cane, and other vegetable substances, which are saturated with bacteria, yeast cells, and mould fungi. Yeast is *S. Vordermanni* and *Monilia javanica*. *Mucor oryzae* and *Rhizopus oryzae* both turn starch into sugar, which is then fermented by *S. Vordermanni* and *M. javanica*. The former gives a very fine arrack, the latter alcohol with a bad taste.

II. Those which ferment dextrose and sucrose, but not maltose.

S. Marxianus, exignus, Ludwigii, Saturnus.

III. Those which ferment dextrose, but neither sucrose nor maltose.

S. mali Duclauxi.

IV. Those species which ferment neither maltose, dextrose, nor sucrose.

S. membranaefaciens, hyalosporus, farinosus.

V. Those species which can ferment lactose.

S. fragilis.

This mere sketch set out in its most expanded form is miserably insufficient even to touch on the points of interest in regard to the wonderful Fungus. The particular physiological point which I had my attention drawn to in regard to anærobic culture I have been unable, through stress of various circumstances, to get a decision on, but it led to the drawing up of this paper, that may direct the attention of some to a closer study of the microflora, which still remains practically untouched in its more local aspects. Of literature there is abundance, and to any one who feels the study may be too trivial, the fact that it required 135 pages, double column, in a large octavo volume to give a list of the various books available on the branch relating to technical mycology alone, and that there are other branches, may give sufficient heart.

XXIV.—*Notes on some New and Rare Fungi from the District.*

By JAMES MENZIES.

(Read Feb. 13th, 1913).

The season of 1912 was not a favourable one for the growth of Fungi, notwithstanding the abundant rainfall. This, we think, may safely be attributed to the low temperature of the summer months, and which was especially marked in August. Many species which we had seen or gathered for years past either did not appear in their usual haunts or were only represented by a few undersized or deformed specimens. It is, however, well known that these abnormal seasons are often productive of species which are very rare or do not appear in normal ones, and the appearance of at least some of those I will mention may be due to these unusual conditions. For the identification of a number of these I am greatly indebted to Monsieur Boudier, the well known French mycologist, author of the "Descomycetes de Europe," a standard work on this subject.

One of the fascinations of fungus collecting is that it is full of surprises; it is often the unexpected that happens, and this was well exemplified when in June last I discovered *Tricharia gilva*, Boud., on the Gannochy Road, about five minutes' walk from my own door. Four years ago this road underwent some repairs, during which a quantity of fine yellow clay was excavated, a slight coating of this being left by the hedge side, and on this the plant appeared at intervals for two months. *Tricharia gilva* was hitherto only known in this country from Yorkshire.

Owing to the great heat and drought of the previous summer the grasses suffered severely, many of them being killed outright. This was very marked on the shallow soils of the Muirhall quarry. The following spring we found some dead clumps of *Dactylis glomerata* affected by a small white fungus in great numbers, this proved to be *Dasyscypha perplexa*, Boud., a species not hitherto found in Britain.

On the soft damp soil at the margin of the pool in the quarry we discovered *Boudiera areolata*, Cook, and which appeared at intervals for six weeks. Easily sectioned, this is one of the most interesting of the *Pezizae* under the microscope. Asci, spores and paraphyses are large, the spores being ornamented by prominent spines which are sometimes connected by a membrane. This, however, our species did not develop. The plant may not be so rare as it is supposed to be, but it will always be difficult to find, as it is almost the colour of the soil on which it is found growing.

In the excavation of the reservoir near this, the quarry was used as a convenient dumping-ground for many tons of boulder clay, forming one great heap, and Nature has been busy ever since trying to clothe this rank material. She has been fairly successful with the top of the heap, but the sides as yet are rather bare; amongst the first plants to get a footing was the broom. For several years in the autumn we have been finding on the clay about the roots of these broom bushes a pretty *Discomycete*, ranging in colour from pale pink to deep rose, the plant varying in shade in proportion to the illumination to which it is exposed. Sometimes it is gregarious and small, and at other times solitary and reaching two centimetres across.

It is not by any means scarce, and when it appeared during the past autumn we submitted specimens to M. Boudier, who assures me that it is a new species, and he has kindly described and named the plant. In this he has done me the honour of associating my name with it as *Calycella Menziesia*, Boud.

In a former paper we referred to the charcoal heaps as a favourite habitat for many species of *Pezizae.*

In going over some of these at Kinfauns in July we discovered *Pustularia Patavina*, Sacc., a yellowish plant furnished externally with numerous long hyaline hairs, giving the plant a strong resemblance to the *Neottiella.* Fairly large and densely caespitose at first, it appeared at intervals until the end of September, becoming gradually smaller and scattered in growth. In Cook's Mycographia this species is recorded from Italy; it is also found in France, but this, I believe, is the first time it has been found in Britain. The charcoal heap in this instance was an old one and covered with the weaker mosses. While collecting this species, at first I was an object of curiosity to some of the wayfaring fraternity who had kindled a fire here for culinary purposes. A few weeks later we were surprised to find the remains of this fire, which had been well soaked by rain in the interval, covered with a dense crop of orange and brown fungi. The orange one proved to be *Anthracobia nitida*, Boud., a species not described in our floras; its brown companion on the ashes being *Humaria maurilabra*, Sacc., a nearly allied species but possessing quite distinctive characteristics. During the summer and autumn the charcoal heaps produced a crop of *Geopyxis carbonaria*, Sacc., a small but sometimes elegant species resembling in miniature the Communion Cup of pre-sanitary times. The appearance of this species we believe to have been due to the nature of the season, not a trace of it having been found in the locality before, and it was found at Dunkeld by Mr. M'Intosh at the same time.

Another interesting plant found in our neighbourhood is *Humaria rubens*, Boud. We have been finding this species for several years,

but until this year its identification had not been satisfactorily settled. *Humaria rubens* is a minute species, bright red when growing in dry weather, but changes to dull red with wet. It is found sometimes on bare soil, but more often pushes its way upwards through the finer mosses, either singly or in little groups. It is confined, so far as we have found, to the rocks and soil of the Sidlaws, where it occurs from the lowest outcrop of the andesite on the Dundee Road over the hills as far as the Lyndoch Monument, beyond which we have not as yet been able to examine the ground.

This species has only been known in this country from Yorkshire.

In October, when prospecting on Kinnoull, we came across an interesting fungus occupying the fallen leaves of *Pinus sylvestris*. So closely did this species resemble some of the minute *Marasmii* that only the microscope settled the point. I am indebted to Mr. Carleton Rea for its identification as *Helotium nigripes*, Pers. Differing from the great majority of the *Discomycetes*, this one is at first convex and furnished with a fairly long stem, which gradually darkens to the base where it is quite black. It is also somewhat exceptional in possessing only four spores in the ascus and no paraphyses. There is no record of this one being previously found in the country.

My last species I have recorded in a previous paper, and my present reference to it is of the nature of a correction. In that paper I mentioned *Sepultaria arenicola*, Mass., as being found at Quarry Mill. Specimens, however, submitted to M. Boudier were referred by him to *Sepultaria foliacea*, Shaff., a much rarer species, and his description of the plant, manner of growth and habitat, leaves no room for doubt on the subject.

Although going out of my locality, I should like to mention a little excursion by Mr. M'Intosh and myself to Ballinluig in August last, our object being the search of the sandy haughs there for some of the *Pezizae* which affect soils of this nature. In this we were not quite successful, the weather turning out wet, and we were driven to seek shelter quite early in the day. Enough, however, was found to show that our expectations were not unfounded, but these will have to wait until another season when more material is found. On the sandy ground *Liptonia serrulata*, Fr., was found in some quantity. This is not very common in Perthshire.

The rain moderating somewhat, we travelled down to Guay by Tullymet. On road scrapings we met with a long line of yellowish cups which proved to be *Peziza subrepanda*, C. K. and Phil., and underneath some larch trees by the wayside we collected specimens of *Tricholoma luteo-citrinum*, Rea, a rare species of this genus.

XXV.—*Perthshire Diptera—Aberfoyle District.*

By A. E. J. CARTER.

(Read 10th April, 1913.)

In again bringing before our Society some account of the species of Flies found in the County of Perth, I have thought it useful on this occasion to give as complete a list as possible of the species I have taken at Aberfoyle. The locality is an interesting one to Perthshire naturalists, as it is situated in the far south-western corner of the county, and in the drainage area of the Forth, not of the Tay. It lies, too, on the line of the great fault, which passes through Aberfoyle on towards Callander. I did not do much collecting on the Lowland side of the line, but confined myself chiefly to the wooded shores of Loch Ard, and to the hills, over which I wandered as far as the Trossachs and Loch Katrine. The ground covered did not rise above the 1000 ft. line.

The visits paid to Aberfoyle were as follows:—

(1.) 30th June to 12th July, 1901.
(2.) 27th June to 18th July, 1903.
(3.) 30th June, 1904.
(4.) 2nd to 19th September, 1905.
(5.) 20th August to 3rd September, 1906.

The above reference numbers (1 to 5) are given after each name in the list, to conveniently record the occasions on whlch the species occurred. Taking into account the time spent in the district, my list may seem a short one, but all my time was not given to collecting, and during (1) and (2) *aculeate Hymenoptera* were my principal quest. Again, I did not collect with the idea of making a list, and no specimens or records were kept of many familiar species.

The nomenclature used is chiefly that of Verrall's list (1901). It is much to be desired that a uniform system should come into use: the present confusion is bewildering.

A few species of special interest may be noted:—

Polylepta leptagaster—So far as I know the only British specimen.

Dicranomyia rufiventris—The same remark applies to this.

Oxycera dives—(Ent. Mo. Mag., 1904, p. 16)—I took three males. These and a male from Rannoch and a specimen from Dumbartonshire are the only authentic British examples.

Atylotus fulvus—In Scotland this has been recorded only from Banchory.

Hybos grossipes—This name in Verrall's list = *culiciformis*, Fab.; my insect was new to Britain, see Ent. Mo. Mag., 1912, p. 59.

Rhamphomyia culicina—Recorded as new to Britain by myself in Ann. Sct. Nat. Hist., 1911, p. 83.

Dolichopus caligatus—So far as I know the only British example of this species.

Sphecolyma inanis—The larvæ of this peculiar anthomyid have been found in swarms in the nest of the wasp *Vespa germanica* (Ent. Mo. Mag., 1891, p. 41). Besides Aberfoyle, it has, I think, been recorded in Scotland only from Murroch Glen.

Hydrotæa pilipes—My captures were introduced as new to Britain by Mr. Grimshaw (Ann. Scot. Nat. Hist., 1904, p. 158). He also described the female (previously unknown) in Ent. Mo. Mag., 1905, p. 247.

Homalomyia carteri (=*femorata*, Mall.)—Only one specimen known; *Cf.* Ent. Mo. Mag., 1910, p. 67, and Scot. Nat., 1912, p. 136.

Mycetophilidæ—
Sciara thomæ, L. 4, 5.
Cordyla sp., 4.
Mycetophila punctata, Mg. 4, 5.
lineola, Mg. 5.
? signata, Mg. 4.
Rhymosia fasciata, Mg. 4.
Exechia tenuicornis, V.d.W. 5.
sp. 4.
Allodia lugens, Wied. 4.
Phronia signata, Winn. 5.
Sceptonia nigra, Mg. 4.
Claphyroptera facipennis, Mg. 5.
Boletina trivittata, Mg. 4.
basalis, Mg. 4.
sp. 4.
Polylepta leptogaster, Winn. 4.
Hertwigia marginata, Dz. 5.
Tetragoneura sylvatica, Curt. 4, 5.
Sciophila tumida, Winn. 5.
incinsurata, Zitt. 4.
sp. 4.
sp. 4, 5.
Macrocera angulata, Mg. 5.
Bolitophila cinerea, Mg. 4.

Bibionidæ—
Dilophus febrilis, L. 4.
Bibio pomonæ, F. 5.
Simuliidæ—
Simulium reptans, L. 4.
latipes, Mg. 4.
Culicidæ—
Ochlerotatus lateralis, Mg. 4.
Culex pipiens, L. 4, 5.
Limnobiidæ—
Dicranomyia ?stigmatica, Mg. 5.
rufiventris. Strobl. 5.
sp.
Rhipidia maculata, Mg. 5.
Molophilus appendiculatus, Stæg. 4, 5.
Rhypholophus varius, Mg. 4, 5.
hæmorrhoidalis, Zitt. 5.
Erioptera flavescens, Mg. 5.
Limnophila meigenii, Verr. 5.
lineolella, Verr. 4, 5.
aperta, Verr. 5.
bicolor, Mg. 5.
nemoralis, Mg. 5.
Trichocera hiemalis, Deg. 4.

Amalopis littoralis, Mg. 4.
Pedicia rivosa, L. 4, 5.
Tipulidæ—
Pachyrrhina imperalis, Mg. 5.
lineata, Scop. 5.
Tipula confusa, v.d. W. 4, 5.
lateralis, Mg. 5.
lutescens, F. 4, 5.
oleracea, L. 4.
paludosa, Mg. 4, 5.
Rhyphidæ—
Rhyphus fenestralis, Scop. 4, 5.
Stratiomyidæ—
Oxycera dives, Lw. 2.
Sargus flavipes, Mg. 5.
irridatus, Scop. 2, 3.
Microchrysa polita, L. 2.
Tabanidæ—
Hæmatopota pluvialis, L. 1, 2, 5.
crassicornis, Whlbg. 1, 2.
Therioplectes distinguendus, Verr. 1, 2, 3.
Atylotus fulvus, Mg. 1.
Tabanus sudeticus, Zlr. 2, 5.
Chrysops relicta, Mg. 1.
Leptidæ—
Leptis scolopacea, L. 1, 2, 3.
tringaria, L. 5.
lineola, F. 1, 2, 4, 5.
Chrysopilus cristatus, F. 1, 2.
Asilidæ—
Isopogon brevirostris, Mg. 2.
Empidæ—
Hybos culiciformis, Fab. 4.
grossipes, L. 4.
femoratus, Müll. 4, 5.
Crytoma intermedia, Lund. 4.
Rhamphomyia spinipes, Fln. 4.
variabilis, Fln. 4, 5.
culicina, Fln. 2, 4.
n. sp. 5.
Empis tessellata, F. 2.
livida, L. 1, 2.
trigramma, Mg. 1.
pennipes, L. 5.
Hilara interstincta, Fln. 5.
maura, F. 1, 2.
flavipes, Mg. 4, 5.
Trichina flavipes, Mg. 4.
Ocydromia glabricula, Fln. 4.
Clinocera (Kowarzia) bipunctata, Hal. 5.
Hemerodromia precatoria, Fln. 4.
melanocephala, Hal. 4.
Lepidomyia melanocephala, F. 5.
Tachypeza nubila, Mg. 4.
Tachydromia nigritarsis, Fln. 4.
longicornis, Mg. 4.
Dolichopodidæ—
Psilopus platypterus, F. 5.
Dolichopus atripes, Mg. 4, 5.
vitripennis, Mg 5.
atratus, Mg. 2.
discifer, Stan, 2, 3, 5.
signatus, Mg. 5.
caligatus, Whlbg. 5.
ungulatus, L. 2.
Hercostomus germanus, W. 5.
nigripennis, Fln. 3.
Hypophyllus obscurellus, Fln. 5.
Cymnopternus ærosus, Fln. 3, 5.
Argyra argentina, Mg. 2, 5.
leucocephala, Mg. 1, 5.
Syntormon zelleri, Lw. 4.
Hydrophorus borealis, Lw. 5.
Liancalus virens, Scop. 4, 5.
Campsicnemus loripes, Hal. 4, 5.
Lonchopteridæ—
Lonchoptera lutea, Pz. 4.
punctum, Mg. 4.
Phoridæ—
Trineura aterrima, F. 2.
Aphiochæta alticolella, Wood. 5.
Platypezidæ—
Platypeza picta, Mg. 4.
Pipunculidæ—
Verrallia aucta, Fln. 3.
Pipunculus campestris, Ltr. 3, 4, 5.
strobli, Verr. 4.
xanthropus, Thoms. 5.

Syrphidæ—
Paragus tibialis, Fln. 2.
Pipizella, flavitarsis, Mg. 1, 2, 3.
Pipiza noctiluca, L. 4.
Liogaster metallina, F. 2.
Chryogaster solstitialis, Fln. 2.
hirtella, Lw. 3.
Chilosia antiqua, Mg. 2, 3.
longula, Ztt. 5.
fraterna, Mg. 1.
proxima, Ztt. 2, 5.
Platychirus peltatus, Mg. 2.
scutatus, Mg. 2.
albimanus, F. 2, 5.
scambus, Stoeg. 1.
angustatus, Ztt. 1.
Pyrophaema rosarum, F. 5.
Melanostoma mellinum, L. 1, 2, 5.
scalare, F. 2, 4, 5.
Leucozona lucorum, L. 1.
Ischyrosyrphus glaucius, L. 1, 2, 5.
laternarius, Müll. 2.
Syrphus albostriatus, Fln. 4.
lunulatus, Mg. 1, 2, 5.
ribesii, L. 1, 2, 3, 5.
vitripennis, Mg. 2.
corollæ, F. 1.
bifasciatus, F. 2.
balteatus, Deg. 4.
cinctellus, Zett. 1, 2, 5.
cinctus, Fln. 2, 5.
maculicornis, Ztt. 1.
compositarum, Verr. 2.
arcticus, Zett. 2.
Sphærophoria scripta, L. 2, 5.
menthastri, L. 1.
Baccha obscuripennis, Mg. 3.
Ascia podagrica, F. 5.
Rhingia campestris, Mg. 2.
Volucella bombylans, L. 1, 2.
pellucens, L. 2.
Eristalis tenax, L. 5.
pertinax, Scop. 2, 3, 4, 5.
rupium, F. 1, 2.
horticola, Deg. 1, 2, 3, 5.
Myiatropia florea, L. 1, 5.
Helophilus pendulus, L. 1, 2.
Xylota segnis, L. 1, 4, 5.
florum, F. 5.
Syritta pipiens, L. 3, 5.
Chrysochlamys cuprea, Scop. 1.
Arctophila mussitans, F. 5.
Sericomyia borealis, Fln. 1, 2, 3, 5.
Chrysotoxum arcuatum, L. 2.
bicinctum, L. 1.
Microdon mutabilis, L. 2.
Conopidæ—
Conops flavipes, L. 5.
Tachinidæ—
Exorista sp. near fimbriata, Mg. 5.
Phorocera pavida, Mg. (cilipeda, Rnd. ?), 3.
Micropalpus vulpinus, Fln. 1, 2, 5.
Thryptocera crassicornis, Mg. 4, 5.
bicolor, Mg. 2.
Siphona geniculata, Deg. 2, 5.
Trixa œstroidea, Dsv. 1, 5.
Cynomyia alpina, Ztt. 2.
Sarcophaga carnaria, L. 1, 5.
similis, Mde. 1, 2.
atropos, Mg. 1, 2.
? agricola, Mg. 3, 5.
Metopia leucocephala, Rossi. 1, 2, 3.
amabilis, Mg. 2.
Dexiosoma caninum, F. 1, 2.
Dexia vacua, Fin. 1, 5.
Myiocera carinifrons, Fln. 2, 4, 5.
Muscidæ—
Stomoxys calcitrans, L. 4.
Pollenia rudis, F. 2, 4, 5.
Myiospila meditabunda, F. 3.
Graphomyia maculata, Scop. 5.
Musca domestica, L. 4.
Morellia simplex, Lw. 4, 5.
hortorum, Fln. 1, 2, 3.
Mesembrina meridiana, L. 5.
Pyrellia cyanicolor, Ztt. 1, 2, 3, 4, 5.
eriophthalma, Mcq. 5.
Protocalliphora grœnlandica, Ztt. 2, 5.

Calliphora vomitoria, L. 2.
Euphoria cornicina, F. 5.
Lucilia cæsar, L. 1, 2, 4.
Anthomyidæ—
Polietis lardaria, F. 2, 3, 4, 5.
albolineata, Fln. 2, 3.
Hyetodesia incana, W. 3.
lucorum, Fln. 2, 3.
umbratica, Mg. 4.
semicinerea, W. 2, 3.
errans, Mg. 4, 5.
signata, Mg. 2, 4.
basalis, Ztt. 1, 2.
rufipalpis, Mcq. 5.
scutellaris, Fln. 2, 4.
pallida, F. 1, 2, 3.
Allœostylus flaveola, Fln. 5.
Mydæa vespertina, Fln. 1, 2, 4.
u rbana, Mg. 1, 2, 4, 5.
pagana, 1, 2, 3, 4, 5.
impuncta, N. 1, 2, 3.
Sphecolyma inanis, Fln. 2.
Spilogaster nigrinervis, Ztt. 1, 2, 3, 5.
quadrimaculata, Fln. 2.
duplicata, Mg. 1, 2.
consimilis, Fln. 1, 2.
Limnophora solitaria, Ztt. 1, 2, 3, 5.
? triangula, Fln. 5.
Macrorchis meditata, Fln. 2, 3.
Hydrotæa irritans, Fln. 1, 2, 3.
dentipes, F. 3, 5.
palæstrica, Mg. 3.
similis, Mde. 2, 3, 4, 5.
militaris, Mg. 1, 2, 3, 4, 5.
pilipes, Stein. 2.
Ophyra leucostoma, W. 2.
Drymia hamata, Fln. 1, 4, 5.
Trichopticus semipellucidus, Ztt. 5.
Hylemyia lasciva, Ztt. 3.
flavipennis, Fin. 3, 5.
strigosa, Fln. 2, 5.
nigrimana, Mg. 2, 5.
Mycophaga fungorum, Deg. 5.
Anthomyia pluvalis, L. 2, 4.
radicum, L. 2.
Phorbia transversalis, Ztt. 4, 5.
Pegomyia hæmorrhoum, Ztt. 3.
latitarsis, Ztt. 1, 3.
bicolor, W. 1, 2.
nigritarsis, Ztt. 4.
fulgens, Mg. 4.
vittigera, Ztt. 2.
Homalomyia carteri, Mall. 3.
aërea, Ztt. 3, 4, 5.
serena, Fln. 4.
Azelia macquarti, Stoeg.
cilipes, Hal. 4.
triquetra, W. 4.
gibbera, Mg. 4.
Caricea means, Mg. 2.
Cœnosia sp. near sexnotata, Mg. 4.
geniculata, Fln. 5.
Cordyluridæ—
Parallelomma albipes, Fln. 4.
Scatophaga suilla, F. 1, 2, 4, 5.
maculipes, Ztt. 2.
lutaria, F. 2, 4.
stercoraria, L. 2, 5.
squalida, Mg. 2, 4.
Borboridæ—
Borborus nitidus, Mg. 4.
equinus, Fln. 4.
Limosina fontinalis, Fln. 4, 5.
Dryomyzidæ—
Dryomyza flaveola, F. 3, 4.
decrepita, Ztt. 5.
senilis, Ztt. 2, 4, 5.
Neuroctena anilis, Fln. 1, 2, 4, 5.
Helomyzidæ—
Helomyza inornata, Lw. 5.
? hilaris, Ztt. 5.
bicolor, Ztt. 4, 5.
Allophyla atricornis, Lw. 5.
Leria ruficeps, Ztt. 4.
? near pusilla, Lw. 4.
Tephrochlamys rufiventris, Mg. 2.
Sciomyzidæ—
Tetanocera elata, F. 1, 2, 3, 4, 5.
lævifrons, Lw. 1, 2, 5.
Elgiva albiseta, Scop. 4.
lineata, Fln. 5.

Sapromyzidæ—
Sapromyza rorida, Fln. 4.
Lonchæidæ—
Lonchæa chorea, F. (vaginalis, Fln.) 1, 2, 3.
Palloptera usta, Mg. 5.
Ortalidæ—
Pteropæctria frondescentiæ, L. 3.
Trypetidæ—
Tephritis vespertina, Lw. 4.
Sepsidæ—
Sepsis violacea, Mg. 4.
cynipsea, L. 4.
? nigripes, Mg. 5.
Nemopoda sp. 4.
Piophila nigriceps, Mg. 4.
vulgaris, Fln. 4.
Psilidæ—
Psila nigricornis, Mg. 4.
Loxocera albiseta, Schrk. 5.
Drosophilidæ—
Drosophila funebris, F. 4.
sp. near obscura, Fln. 4.
Geomyzidæ—
Diastata fulvifrons, Hal. 4, 5.
Balioptera combinata, L. 4.

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