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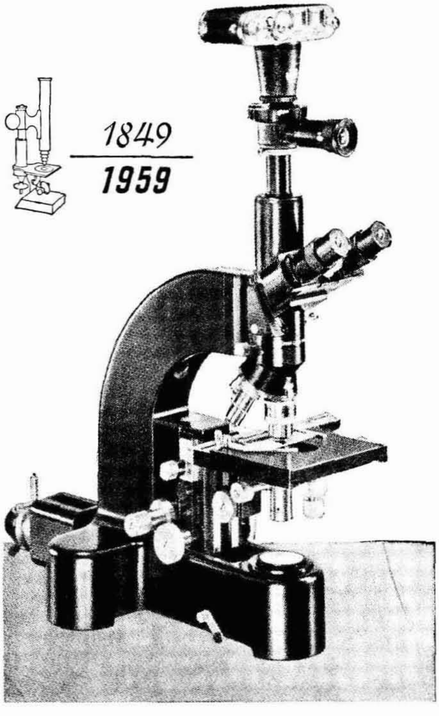
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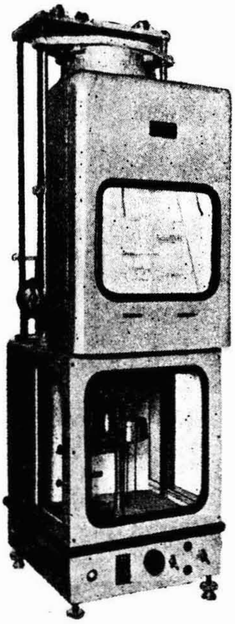
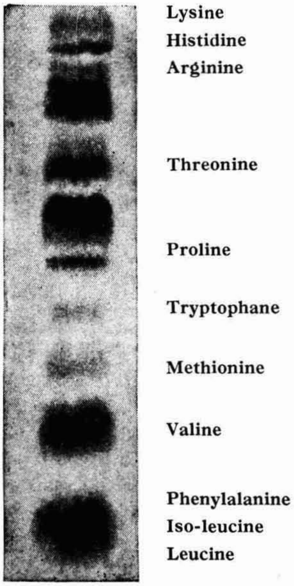
Letters to the Editor





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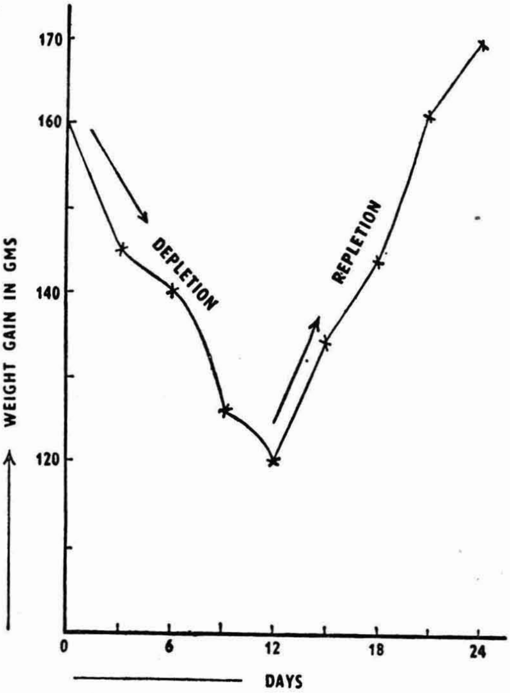
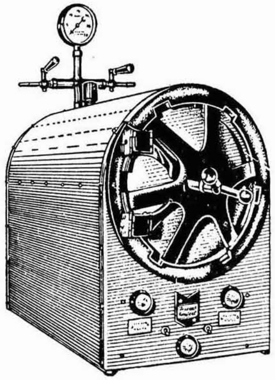


Weight response of protein depleted rats to feeding of Hydroprotein.



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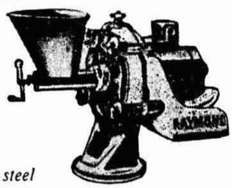

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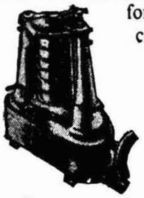

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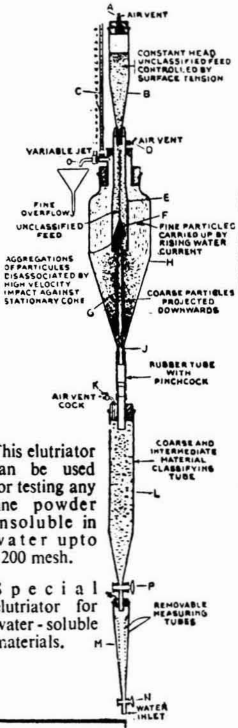

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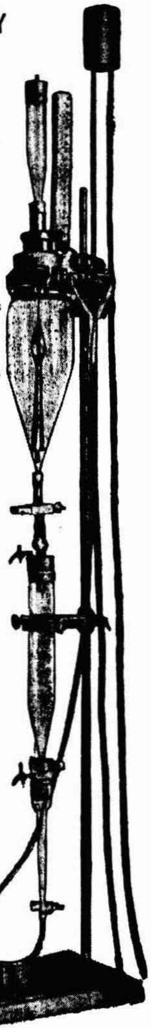

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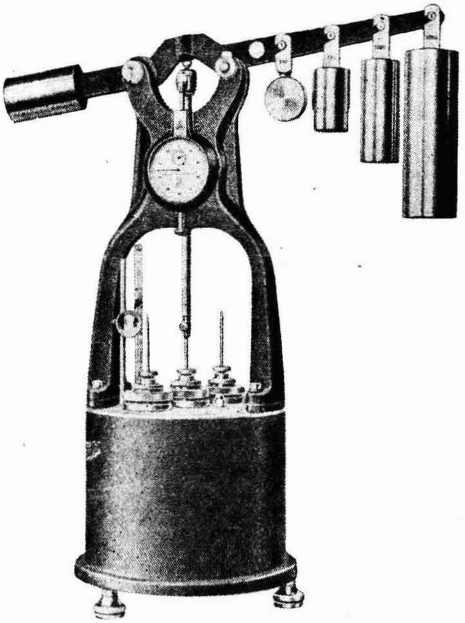

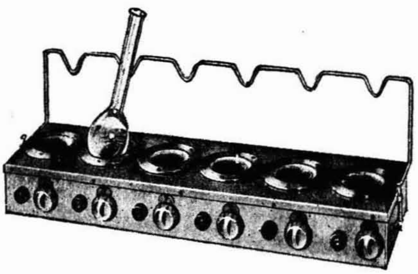

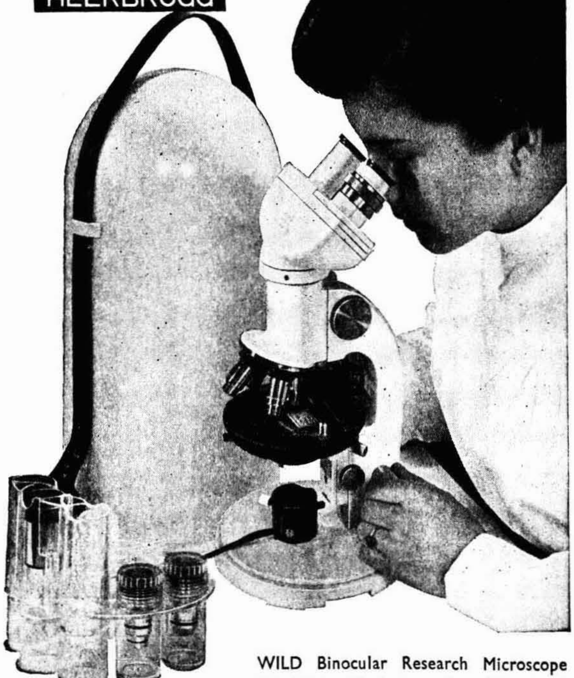

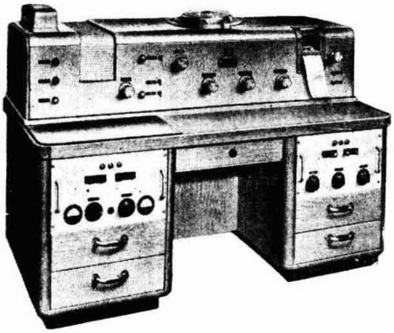

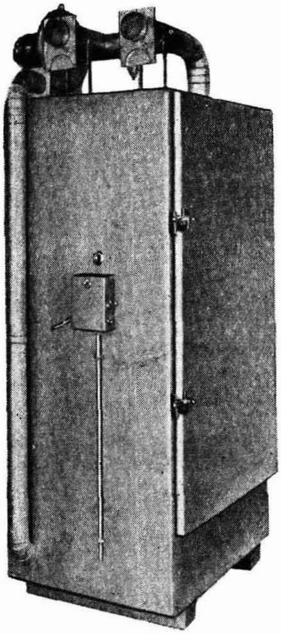

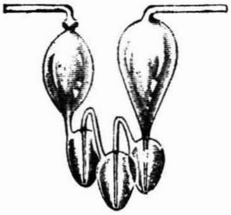

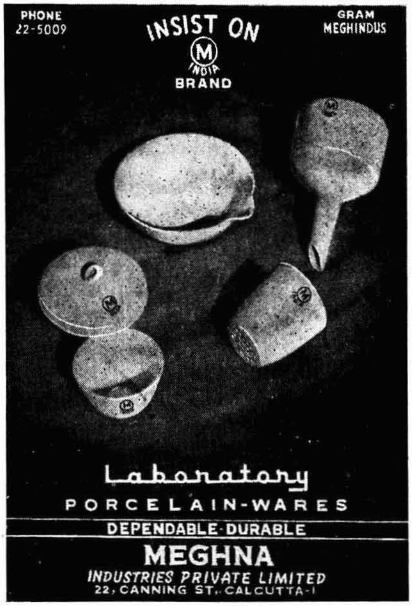

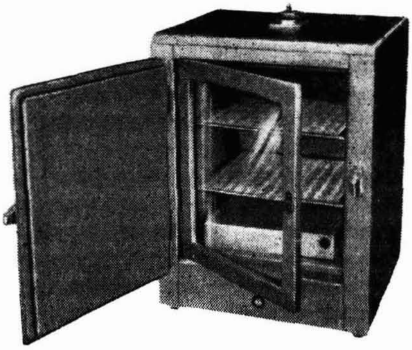

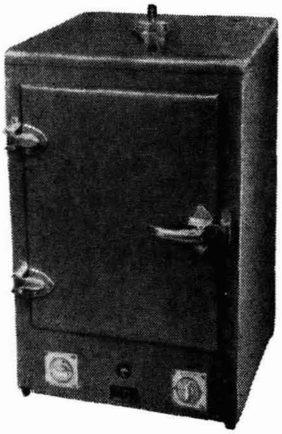

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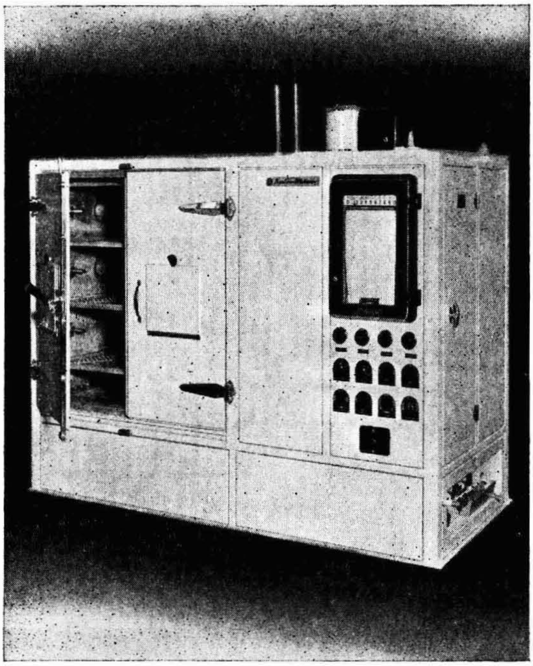

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Current Topics

SHANTI SWARUP BHATNAGAR MEMORIAL AWARD

DR K. S. KRISHNAN, F.R.S., DIRECTOR, NATIONAL Physical Laboratory of India, New Delhi, has been awarded the first Shanti Swarup Bhatnagar Memorial Award for the year 1958. The award was instituted by the Council in 1957, in memory of late Dr S. S. Bhatnagar, for the best research contribution in any field of scientific research (including engineering and technology) by an Indian research worker or a team of research workers.

In recent years, Dr Krishnan's investigations have been mainly concerned with work on the frequencies and anharmonicities of alkali halide crystals and on a critical analysis of the difference between the characteristic frequencies which appear in the dispersion formula of Drude and Lorentz. His work in the field of thermionics relates to the determination, with a high degree of accuracy, of the thermionic constants of graphite, the metals of the iron group, and of the monovalent metals, copper, silver and gold. The energy barrier at the surface of a monovalent metal, the thermodynamic potential of the electrons and the work function in metals have been investigated by Dr Krishnan and his associates, and they have shown, from the observed variation in the work function, that it appears as though the electrons in the metal and in the vapour form the phases of a single component thermodynamic system. They have further shown that both the thermal expansion of the lattice and the thermal agitation of the atoms affect the work function of the metal, but the effects of the two cancel each other. Another problem of an applied character which engaged the attention of Dr Krishnan and his collaborators was the distribution of temperature along a thin rod (or wire) electrically heated *in vacuo*. This problem has been investigated from theoretical and experimental points of view. On the theoretical side, an appropriate differential equation has been formulated; the equation has been solved in a practically usable form both for long and short filaments. On the experimental side, measurements have been carried out on thin rods of Acheson graphite and platinum filaments, and the theoretical results have been verified. These investigations have brought orderly thinking into a complex but very practical subject and made the way easier for further advances in the field.

PRODUCTION OF SYNTHETIC VITAMIN A

WITH THE ESTABLISHMENT OF THE PLANTS FOR THE production of synthetic crystalline vitamin A on a commercial scale by Roche Products Ltd and the Glaxo Laboratories Ltd at Bombay, India becomes the sixth country in the world to undertake commercial synthesis of this vitamin. The Roche plant will be producing 10 million mega units of the vitamin in the form of its acetate and palmitate, and the Glaxo plant 5 million mega units as vitamin A palmitate. This quantity is expected to meet the present demand for the vitamin in the country. At present both the plants will be employing C-20 diol, an intermediate, as the starting material; this intermediate is imported. Ultimately, these plants propose to undertake the complete synthesis of the vitamin starting from β-ionone to be obtained from citral, a constituent of lemongrass oil available in abundance in India, or from acetone.

This development is of considerable significance to India in many ways, and particularly from the point of human nutrition, since vitamin A deficiency is widespread and is next only in importance to protein deficiency, and the availability of vitamin A in adequate amounts will go a long way in improving the nutritional status of the people. The establishment of these plants will ensure the supply of this nutritionally important vitamin in a standardized form and at a reasonable price. The impact of this development on pharmaceutical and food industries will be considerable. The availability of vitamin A in a wide range of forms and types of products will greatly facilitate the work of the food technologist, the pharmaceutical chemist and the worker in the veterinary field. It will help the pharmaceutical industry to put on the market a variety of vitamin preparations in which vitamin A is an important constituent. The synthetic product has many desirable qualities such as high degree of purity and stability, excellent absorption, and freedom from fishy odour, characteristic of vitamin A concentrates derived from fish liver oils. Its large-scale production will facilitate its widespread use in infant and invalid foods, and in the enrichment of foodstuffs such as vanaspati, butter, ghee, bread, etc. It may also find other uses, for example, in increasing the productivity of livestock.

Considerable expansion has been envisaged in the drugs and pharmaceuticals industry and in the dyestuffs and intermediates industry during the second and third plan periods. India is expected to become self-sufficient with respect to drugs and pharmaceuticals during the third plan period and the output of these products, it is estimated, will be worth Rs 150 crores. In view of these projected developments, the establishment of these two plants has many important implications. The production of synthetic vitamin A involves delicate and exacting production techniques, rigorous control, the use of specialized equipment, and the services of highly trained and skilled chemists and chemical engineers. These plants should provide valuable opportunities for the specialized training of chemical engineers and production chemists needed for the rapidly expanding and developing fine chemicals and drugs and pharmaceutical industries.

DURGAPUR COKE OVEN PLANT

THE INAUGURATION OF THE COKE OVEN PLANT OF THE Durgapur Industries Board, West Bengal, by the President of India on 14 March 1959 is a positive step towards the organization of coal-based industries in India. A major project of the West Bengal State in the Second Five-Year Plan, the coke oven plant together with its ancillary industries is expected to cost Rs 14·5 crores and will be completed in two major phases: the establishment of chemical industries in the first and the metallurgical industries in the second. With an installed production capacity of 325,000 tons of coke per year, the plant — the second largest in the country — will supply part of the fuel requirement of various industries in the Durgapur industrial area and will also form the nucleus of a coal-based chemical industry. Plans are under various stages of formulation for the indigenous manufacture of chlorobenzene and nitrobenzene group of intermediates required for dyestuffs, drugs, insecticides, plastics and a host of chemical industries. The demand for benzene and toluene by 1960-61 is estimated at 2,860,000 and 500,000 gallons respectively, and of phenol and naphthalene at 1200 and 3000 tons respectively. This plant, together with the coke oven plants at Bhilai and Rourkela steel plants, is expected to meet the demand for these products. Special cokes required for calcium carbide, ferromanganese, malleable alloy casting industries, etc., which are now largely imported, will also be supplied from this plant.

Apart from the coke oven plant, the various sections of the integrated Durgapur project will include: recovery of the byproducts; byproducts utilization plant; a coal-tar distillation plant with a throughput of 50-100 tons per day; a coke oven gas purification plant; a gas grid for supplying gas to Asansol-Calcutta area for industrial and domestic consumption; and a 60,000 kW. thermal power station utilizing high ash pulverized coal and coke oven gas with arrangement for the production of process steam required for the coke oven and the chemical plant. Of these, the coke oven and the byproducts plants have been completed: they will carbonize 1400 tons of blended coal per day to produce 1000 tons of hard coke, 9000 gallons of tar, 4500 gallons of crude benzol, 20 tons of ammonia and ammonium sulphate and 15 million cu. ft of gas.

Symposium on Vitamin A

TAKING advantage of the occasion of the inauguration, on 21 February 1959, of their plant in Bombay for vitamin A manufacture by Roche Products, and the presence of the Swiss scientists, the Bombay branch of the Society of Biological Chemists, India, organized a symposium on vitamin A and other fat-soluble vitamins.

Dr Otto Isler, Director of Chemical Research, Hoffmann-La Roche, Basle, presented two papers, one relating to the synthesis of vitamin A and the other to the synthesis of the fat-soluble vitamins. The successful commercial synthesis of vitamin A by Isler and co-workers in 1947 was made possible because they avoided routes which give rise to sensitive or unstable intermediates. In their synthesis, the β-C_{14}-aldehyde, an essential intermediate, is condensed with a C_6 side chain by a Grignard reaction. The crystalline condensation product is partially hydrogenated by means of the Lindlar catalyst. The crystalline product formed on partial hydrogenation is acetylated and dehydrated with rearrangement to give crystalline vitamin A acetate which is purified by recrystallization. Two features of the synthesis are noteworthy: the process leads through two crystalline intermediates to vitamin A acetate with its outstanding crystallizability. The synthesis gives almost exclusively the *trans* form which is the active natural stereoform of vitamin A.

In his second paper, Dr Isler stressed on the close interrelationship of the fat-soluble vitamins and traced the historical development in the recognition of their structural formulae. He then dealt with the syntheses of vitamin E (1938), vitamin K_1 (1939), vitamin A (1947), β-carotene (1950), vitamin A_2 (1951), vitamin K_2 (1957) and vitamin D_3 (1958). He briefly indicated how manufacturing procedures were realized first by Roche for the vitamins A, E and K and for β-carotene.

An interesting account of the biosynthetic pathways for the isoprene unit, common to all the fat-soluble vitamins, and to Morton's ubiquinone or Green's coenzyme Q, was presented. In nature, mevalonic acid is formed from three molecules of acetic acid. This reactive compound leads, on decarboxylation, to the isoprene unit. Two such units are linked in the monoterpenes, linalool and citral, three units in the sesquiterpenes, nerolidol and farnesol, and condensation of 4 units leads to phytol, the main part of the vitamins E and K_1. Squalene is formed from 6 isoprene units, actually by dimerization of sesquiterpenes. It is the parent substance of the sterols and vitamin D_3. The carotenoids are formed from 8 isoprene units most probably by dimerization of diterpenes. Vitamin A, therefore, seems to be derived from carotenoids by degradation. Knowledge concerning biosyntheses of terpenes, carotenoids and sterols is thus getting to be more and more complete.

Dr Oswald Wiss, in charge of biochemical research in Hoffmann-La Roche, gave an account of various aspects of the importance of the fat-soluble vitamins in metabolism. In particular, he discussed vitamin A occurrence, absorption, storage and mobilization as well as the mechanism of conversion of carotene to vitamin A. He referred to recent work on the elucidation of the chemistry of vision and the work of Wald and Morton, to what is as yet only preliminary information concerning the possible implication of vitamin A in glycogen and in corticosteroid syntheses. He compared the structural relationships of ubiquinone and vitamins E and K_2, and mentioned some of his interesting results on the incorporation of mevalonic acid into biosynthesized ubiquinones.

Dr Par Ringnes of the Vitamin Department of Hoffmann-La Roche spoke on problems of vitamin A application in human and animal nutrition, and in the pharmaceutical industry. The substantial range of different forms and types of vitamin A products available today greatly facilitates the work of the food technologist, the animal feed compounder, the pharmaceutical chemist, and the worker in the veterinary field. He also dealt with stability aspects of vitamin A.

Dr V. N. Patwardhan, Director, Nutrition Research Laboratories, Hyderabad, reported that vitamin A deficiency, though next only to protein deficiency, is widespread in India. He discussed the characteristic clinical manifestations of the deficiency and was of the opinion that night blindness and xerosis of conjunctiva can also occur from causes other than deficiency of vitamin A. Phrynoderma and other skin ailments attributed to vitamin A deficiency are often due to other causes like deficiency of essential fatty acids.

Dr B. Mukerji, Director, Central Drug Research Institute, Lucknow, generally surveyed deficiency symptoms of vitamin A and also discussed the pharmacology of the vitamin.

Dr S. M. Patel of the Haffkine Institute discussed effects of dietary factors like proteins, fats, vitamin E and nicotinamide on vitamin A metabolism. He referred to the Sheffield studies on vitamin A reserves in human volunteers and also indicated the possible relationship of vitamin A to the ubiquinones.

Electroplating in East Germany

T. L. RAMA CHAR
Indian Institute of Science, Bangalore

THE Third International Symposium on Electrodeposition was held at Ilmenau, German Democratic Republic (GDR), in October 1958 under the auspices of the Institute for Electro-technology. At the invitation of the Government of the GDR the author proceeded to East Germany and participated in the symposium. This paper gives a short description of the impressions gained, during the brief visit to this country, in the field of electroplating and presents a fair idea of the current trends.

Research and teaching

The papers presented at the International Symposium by scientists from different countries covered the theoretical and industrial aspects of electroplating: automation, new baths like the ethylenediamine for cadmium and pyrophosphate for metals and alloys, high efficiency and speed plating, experimental techniques, role of addition agents, structure of deposits, throwing power measurements, PRC plating, and cleaning procedures. These topics reflect well the type of research work that is being handled in GDR. It is significant to find that the plating industry is encouraging fundamental investigations. The proceedings of the symposium will be published in a special issue of the *Journal of the Institute for Electro-technology*. The Institute for Chemistry, Electrochemistry and Electroplating, Ilmenau, runs a diploma course in electroplating. Teaching facilities of this type are important and provide the technical manpower for research and industry.

Industry

VEB Galvanotechnik, Leipzig (GTL), is the oldest electroplating firm in Europe with 80 years experience in the manufacture of electroplating and polishing supplies. They are the manufacturers of all kinds of electroplating equipment including chemicals, semi- or fully automatic plating machines, electrolytic wire and strip plating plants, and aluminium foil formation plants for electrolytic condenser manufacture. There is a Technical Advisory Service of the GTL in Berlin. Plating equipment is exported to countries in Europe and Asia. In India the GDR has a Trade Representative. The GTL take apprentices for intensive training in industrial plating. They have an Electrochemistry Department which conducts pure and applied research under the guidance of Prof. R. Bilfinger, who is also the editor of the book *VEM-Handbuch Galvanotechnik* (VEB Verlag Technik, Berlin, 1958).

There are many factories in the GDR with large-scale automatic plating plants comparable to those in the U.S.A. The VEB Renag Fabrik fur Fahrradteile, Reichenbach, has an automatic nickel-plating plant for bicycle parts. Steel components are plated with nickel and then with chromium, without the copper undercoat. The nickel plated from a sulphate bath becomes bright about 30 min. after the plating cycle starts, and 2 tons of the metal are plated per year. At Karl-Marx-Stadt the VEB Schrauben-fabrik handles automatic zinc plating of screws. There are 29 barrels using the cyanide bath, followed by a chromate dip. Anodizing of aluminium, including colour anodizing, is also done. Carl Zeiss, Jena, the world famous manufacturers of optical and other instruments, has a large plating section with facilities for anodizing, and plating of dull and bright nickel, copper, chromium, etc.

The plating industry is highly developed in spite of the shortage or lack of the common plating metals in the GDR. It indicates the level of production efficiency with imported raw materials. This aspect is of special significance in India where a similar situation exists with regard to raw material resources. The plating shops are all designed on modern lines with the latest equipment. They are clean, spacious, well ventilated, and provide comfort to the workers.

General

The last war witnessed many advances in plating, chiefly by way of substitutes for critical metals, and new baths and applications to meet special conditions. The experience gained during this period has lead to significant industrial developments in recent years in the U.S.A., U.K., U.S.S.R. and other countries. Alloy plating, for instance of tin alloys, is finding greater importance, and new baths like the fluoborate, sulphamate and pyrophosphate have been established. The automobile industry has switched over to bright anodized aluminium in place of nickel/chromium in the U.S.A. The search continues for a nickel plating bath with good throwing power, or a high efficiency one for chromium. Organic or fused salt baths are being developed for the plating of the difficult metals. Although there do not appear to be any outstanding developments, there is a growing interest in these topics in the GDR.

Conclusion

This brief outline gives a good insight into the modern approach in tackling research problems in electroplating and electrochemistry, and the recent trends in the plating industry in the GDR. The facilities for large-scale automatic plating, training in plating, and electrochemical research in the industry are amongst the highlights. These developments are certainly of great interest to the electroplating developments in India.

Indirect Methods for Rupturing Capacity Tests on High Voltage Circuit Breakers

M. P. VARSHNEY
Indian Institute of Technology, Kharagpur

Manuscript received 31 *July* 1958

Two indirect methods of testing high voltage circuit breakers, viz. (i) synthetic test using charged capacitor and (ii) re-striking voltage supplied by the current generator via a transformer, are discussed, and the general theory of short-circuit currents and arc interruption in a.c. circuit breakers has been outlined. Important factors like frequency of re-striking voltage, short-circuit power factor and time of interruption (one half-cycle or more than one half-cycle) have also been discussed.

In addition to the remarkable flexibility obtainable in indirect testing method by a variation of different factors governing the interruption, it permits a great increase in the short-circuit capacity of existing test stations. The indirect tests are considered equivalent to direct tests under certain conditions, since, with suitable circuits, the results obtained by the indirect method are sufficiently in close agreement with those obtained by the direct method.

THE performance of a high voltage circuit breaker can only be guaranteed after it has been tested at a testing station where high power short-circuit currents are obtainable. Such stations exist in most of the technically advanced countries particularly in those where circuit breakers are manufactured. In view of the progressive increase in the power transmitted and the development of interconnected grid systems, the short-circuit current that could be fed into a fault has increased to such proportions that the existing test stations are not able to fulfil their role completely. The capacity of certain test stations has been increased, but the cost of such transformation is evidently very high. Therefore, the problem of testing circuit breakers of higher rupturing capacities than obtainable at testing stations has given rise to much thought and discussion in recent years. A number of methods have been suggested, and are in use, for replacing the direct tests by indirect tests giving the same guarantees. An actual circuit or a test circuit can be represented diagrammatically as shown by the single-phase circuit of Fig. 1.

Before discussing the indirect methods of testing, it may be useful to briefly outline the general theory of short-circuit currents, and arc interruption in a.c. circuit breakers.

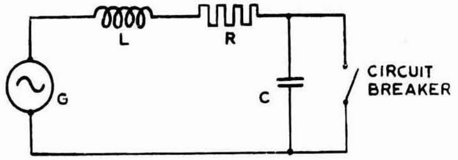

FIG. 1 — CIRCUIT BREAKER TESTING CIRCUIT [G, a.c. generator; L, inductance of the circuit shown concentrated; R, resistance of the circuit shown concentrated; and C, capacitance of the circuit shown concentrated]

Short-circuit currents

The short-circuit current I_{sc} supplied by an alternator consists of three superposed components (Fig. 2):

(i) a.c. component of permanent (steady state) short-circuit current — I_p;

(ii) a.c. transient component — I_t, with exponentially decreasing amplitude depending on the time constant of the field circuit; and

(iii) d.c. component — I_{dc}, having an exponential decrease in magnitude depending on the time constant of the armature circuit.

There is, in addition, a fourth a.c. component I_s called the subtransient component which dies out very rapidly (usually in one cycle). It has a relatively low value for ordinary alternators and can be neglected compared to the total short-circuit current given by its three principal components as indicated above. On the other hand, in a short-circuit generator, its value may reach as high as 20 per cent of the total current and, therefore, cannot be neglected.

The instantaneous value of the d.c. component for a single-phase circuit (one phase of an alternator) is given by the expression:

$$i_{dc} = -\frac{E_{max.}}{Z}\cos(\theta+\phi)e^{-\frac{R}{L}t}$$

where E_{max} = maximum value of the alternator e.m.f. per phase, Z = armature impedance per phase, ϕ = phase difference between voltage and current, θ = electrical angle at the instant of short circuit with respect to the origin (origin being taken at the instant when e.m.f. is maximum, i.e. zero flux in the armature), R = alternator armature resistance per phase, L = total alternator armature inductance per phase, t = time counted from the instant of short circuit, and e = base of naperian logarithms.

It can be seen that if $(\theta + \phi) = 90°$, i_{dc} is zero, whereas if $(\theta + \phi) = 0$, i_{dc} will be a maximum for $t = 0$, and given by

$$I_{dc} = -\frac{E_{max.}}{Z}$$

In case of short circuit, the leakage reactance of alternators, transformers, and lines limits the current, the resistance very often being negligible. It follows from this that the current lags behind the e.m.f. by about $\pi/2$, i.e. $\phi \simeq 90°$.

Then, if X denotes the initial (asynchronous) reactance of the alternator, we have, for $t = 0$, $\theta = 90°$ and $\phi = 90°$:

$$I_{dc} = \frac{E_{max.}}{X} = \sqrt{2}\cdot I_{sc}$$

where I_{sc} = effective value of the total short-circuit current.

On the other hand, for $\theta = 0$, I_{dc} is zero.

Thus if the short circuit is produced at the instant when the voltage is zero ($\theta = 90°$), the d.c. component is maximum and the short-circuit current is termed asymmetrical. Inversely, if the short circuit is produced at the instant when the voltage is maximum ($\theta = 0$), the d.c. component is zero and the short-circuit current is symmetrical. The d.c. component can, in fact, have any intermediate value between these two limits depending on the instantaneous value of the e.m.f. at the instant of short circuit.

Without going into details as to how the current is interrupted, it is clear that for any circuit breaker of a given voltage rating, the difficulties of interruption increase with an increase in the short-circuit current to be interrupted. Current and voltage waves under short-circuit conditions are shown in Fig. 3.

The breaking capacity of a circuit breaker is expressed in amps (together with the rated service voltage) or in kVA. (or MVA.) and is termed:

(i) *Symmetrical breaking capacity*, which is the r.m.s. value of the symmetrical current that the circuit breaker can interrupt. It is shown by $x/\sqrt{2}$ in Fig. 3.

(ii) *Asymmetrical breaking capacity*, which is the r.m.s. value of the asymmetrical current that the circuit breaker can interrupt. It is

$$\sqrt{\left(\frac{x}{\sqrt{2}}\right)^2 + y^2}$$

in Fig. 3.

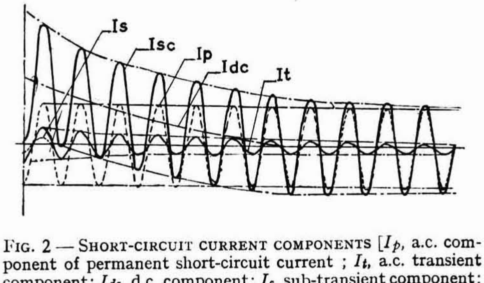

FIG. 2 — SHORT-CIRCUIT CURRENT COMPONENTS [I_p, a.c. component of permanent short-circuit current ; I_t, a.c. transient component; I_{dc}, d.c. component; I_s, sub-transient component; and I_{sc}, total short-circuit current]

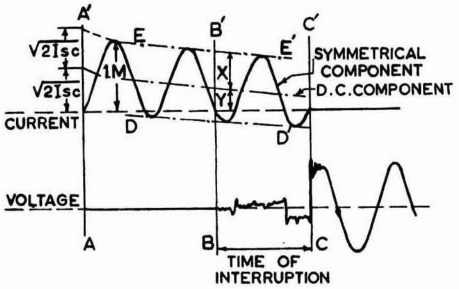

FIG. 3 — CURRENT AND VOLTAGE WAVES UNDER SHORT CIRCUIT [*AA'*, beginning of short-circuit; *BB'*, separation of contacts; *CC'*, interruption completed; and *DD'* and *EE'*, current wave envelopes]

In Fig. 3 is also shown I_M, the short-circuit making current. It denotes generally the peak current against which the circuit breaker can be closed under a given service voltage, and is defined as the peak value of the maximum current wave (including d.c. component) occurring during the first cycle after the circuit breaker is closed on a short circuit. Other things being equal, I_M depends on the value of the d.c. component at the instant of short circuit.

If we take into account the decrement of I_{dc} from the instant the short circuit is produced and take it as 20 per cent:

(i) for $\theta=90°$, $I_M=\sqrt{2}\,I_{sc}+0{\cdot}8\,I_{dc}=1{\cdot}8\sqrt{2}\,I_{sc}\cong 2{\cdot}5\,I_{sc}$

(ii) for $\theta=0$, $I_M=\sqrt{2}\,I_{sc}$ (I_{dc} being zero)

Thus the making capacity is $\leqslant 2{\cdot}5$ times the symmetrical breaking capacity.

Principle of indirect tests

The separation of contacts in a circuit breaker results in the formation of an arc, the voltage across which depends on a number of factors, viz. surrounding medium, current flowing through the arc, length and section of the arc. For a given circuit breaker and for a given contact separation, it can be assumed that the arc voltage depends only on the current flowing through it and is independent of the rated e.m.f. of the circuit if that is much higher than the possible arc voltage, as is always the case in high voltage circuit breakers. The process of circuit breaking can, in fact, be looked upon as composed of two stages, viz. the current interval and the voltage interval. During the current interval which ends at the current interruption (slightly before passage through theoretical zero); for testing purposes it is not necessary to have a power source at the rated service voltage, but it is enough to have a source at a fraction of this voltage (one-third to one-fifth or even smaller) supplying the same current. This evidently reduces the power rating proportional to the voltage. When the arc is extinct, the dielectric strength is gradually built up in the space between the contacts. The second stage (voltage interval) concerns the re-striking voltage, when for testing purposes it is enough to have a voltage source of the correct rating but of very small power and possessing a suitable frequency of its own. It should be noted that if the e.m.f. chosen for maintaining the arc has a proper value with respect to the maximum arc voltage of the circuit breaker, the energy dissipated in the arc in a given time will be the same in a direct test as in an indirect one.

Numerous methods of indirect testing have been proposed, but broadly speaking these can be classified under two heads:

(i) The circuit breaker in one test is supplied with both rated breaking current and rated recovery voltage but from different sources — the voltage source may be simply a charged capacitor. These are called synthetic tests.

(ii) The arc current and the re-striking voltage are supplied by the same alternator through two circuits, the latter via a transformer. This too can be taken as equivalent to two independent circuits.

In any of the above systems, the stresses on the circuit breaker in a direct test may be equalled through proper synchronization of the two sources.

General theory

An elementary diagram of an indirect test circuit is shown in Fig. 4. The voltage, inductance and capacitance of the current-generating circuit are denoted by e_g, L_g and C_g. The corresponding notations for the voltage-producing circuit are e_v, L_v and C_v. *A* and *S* signify disconnecting devices between the two circuits and the test circuit breaker *B*. In the following equations, the indices *g* and *v* are used to denote parameters in the current-generating and the voltage-producing circuits respectively; the corresponding parameters in a direct test circuit being denoted by the index *o*.

In order that indirect test shall give exactly the same stresses on the circuit breaker as a direct test, the instantaneous values of current and voltage must

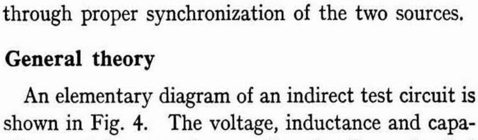

FIG. 4 — CIRCUIT DIAGRAM OF AN INDIRECT TEST CIRCUIT [*G*, current-generating circuit; *B*, test circuit breaker; and *V*, voltage-producing circuit]

be the same in both cases. The conditions during the current interval are governed by the equation:

$$L_g \cdot \frac{di}{dt} + e_b + L_g C_g \frac{d^2 e_b}{dt^2} = e_g \tag{1}$$

where e_b signifies the arc voltage of the circuit breaker. During the voltage interval, the corresponding equation is:

$$\frac{1}{L_v}\int e\,dt + C_v \frac{de}{dt} + i_b = \frac{1}{L_v}\int e_v\,dt \tag{2}$$

where i_b signifies the residual current of the circuit breaker. This is the same equation as (1), only written in another way.

Now, an ideal circuit breaker is one which has neither arc voltage nor residual current. In such a case equations (1) and (2) are reduced respectively to:

$$\frac{di}{dt} = \frac{e_g}{L_g} \tag{1a}$$

$$\text{and} \int e\,dt + L_v C_v \frac{de}{dt} = \int e_v\,dt \tag{2a}$$

It will be seen at once that the following conditions are both necessary and sufficient, if an indirect test is equivalent to a direct one:

$$\frac{e_g}{L_g} = \frac{e_o}{L_o} \tag{3}$$

$$e_v = e_o \tag{4}$$

$$L_v C_v = L_o C_o \tag{5}$$

If its own losses are neglected, the power of the test station may be infinitely small compared with the breaking capacity of the test circuit breaker.

If the circuit breaker is non-ideal, the conditions in equations (3), (4) and (5) are no longer sufficient. As the arc voltage and residual current are the same in an indirect and a direct test, equations (1) and (2) give the following relations necessary for equivalence:

$$e_g = e_o \tag{6}$$

$$L_g = L_o \tag{7}$$

$$C_g = C_o \tag{8}$$

$$e_v = e_o \tag{9}$$

$$L_v = L_o \tag{10}$$

$$C_v = C_o \tag{11}$$

This implies that both the current-generating circuit and the voltage-producing circuit must have a short-circuit power equal to the breaking capacity of the circuit breaker to be tested.

The conclusion from the above must be that it is theoretically impossible to obtain full equivalence between a direct test and an indirect test where the short-circuit power of the test installation is lower than the breaking capacity of the circuit breaker to be tested. This does not, however, necessarily mean that indirect tests are impossible. Even if full equivalence cannot be obtained, it may be possible to arrive at a practical solution, which rather closely approaches the conditions during a direct test.

Indirect testing circuits

The a.c. generator circuit is the most commonly used current-generating circuit. Existing short-circuit generators give a fairly good representation of the short-circuit current. In all indirect tests, it is necessary to have an auxiliary circuit breaker to disconnect the current-generating circuit during the voltage interval. The circuit breaker must be able both to carry the short-circuit current from the current-generating circuit and to withstand the recovery voltage from the voltage-producing circuit. Under certain conditions, to be discussed later, it is possible to use one pole of the test circuit breaker (other pole being the test pole) as auxiliary circuit breaker. One disadvantage of having an auxiliary circuit breaker is that it introduces an extra arc voltage into the circuit and thus a more pronounced deformation of the current. As a rough estimate, however, one may regard this increment as compensated by the diminution when the circuit breaker is tested single phase.

Let us consider the two methods of supplying the re-striking voltage mentioned earlier.

(i) *Synthetic test using charged capacitor* — If the charged capacitor is connected without intermediate circuits, the test circuit breaker is subjected to a voltage surge at a certain time after the main current zero. The surge is usually very steep, and different rates of rise of re-striking voltage are simulated by variation of the time from current zero to the surge impact. This method, however, constitutes merely a measurement of the recovery of the insulation strength of the arc path, and does not take into account the influence of the residual current on the energy conditions. In fact, it cannot give the same re-striking voltage as a direct test.

If the charged capacitor is connected to the circuit breaker via an oscillating circuit, a means is provided for controlling the re-striking voltage. Fig. 5 shows such a circuit that gives correct results even for circuit breakers with residual current. During the current interval, the test circuit breaker is connected to the current source by the auxiliary circuit breaker, the

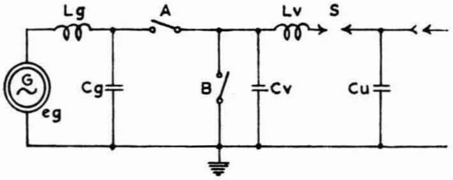

FIG. 5 — CHARGED CAPACITOR (C_u) AS VOLTAGE SOURCE; CONNECTED TO THE TEST CIRCUIT BREAKER (B) VIA A SPARK GAP (S) AND AN OSCILLATING CIRCUIT (L_vC_v). AUXILIARY CIRCUIT BREAKER (A) FOR DISCONNECTING THE CURRENT SOURCE (G).

charged capacitor being disconnected by the spark gap. At the main current zero, the current-generating circuit is disconnected by the auxiliary circuit breaker and the charged capacitor connected by the spark gap. The disconnection of the current circuit is necessary in order to avoid any interference between the voltage and the current circuits during the voltage interval. By controlling the parameters of the oscillating circuit, it is possible to obtain a re-striking voltage equal to the re-striking voltage of a direct test.

If the surge capacitance (C_u) is large compared with the capacitance of the oscillating circuit (C_v), and if, further, its energy content is great compared with the energy lost in the oscillating circuit and in the test circuit breaker (through the residual current), then the voltage across C_u will remain constant during the oscillation period after the flashover of the spark gap. This means that over this period, the network behind C_u may be considered as infinitely strong. The re-striking voltage of the test circuit breaker is then determined by the oscillating circuit, and if its parameters (L_v and C_v) are chosen so that they are equivalent to the corresponding parameters in a direct test circuit, then the conditions of equations (10) and (11) are fulfilled, and thus, equivalence to a direct test obtained even when there is a residual current in the test circuit breaker. The appropriate selection of the values of L_v and C_v is a necessary condition if there is to be equivalence between the synthetic and direct test.

Before proceeding on to the next method, let us consider the synchronizing impulses which assume considerable importance in this case. In order to synchronize the switching from the current-generating circuit to the voltage-producing circuit, a synchronizing impulse is needed at zero current. A simple way is to use the re-striking voltage of the current-generating circuit, but this introduces a delay between the moment of zero current and the application of the re-striking voltage to the test circuit breaker. A better way, that has been proposed by most of the authors dealing with synthetic testing, seems to be to utilize the main current itself. The main current has, however, a very low rate of decay even near its zero and cannot be used directly to obtain a sufficient degree of accuracy in the synchronization. It has to be transformed into a steep voltage impulse occurring at an instant which should be capable of being pre-determined with good accuracy. This can be done by means of a peaking transformer or a specially designed electronic circuit.

(ii) *Re-striking voltage supplied by the current generator via a transformer* — Fig. 6 shows the circuit when transformation from the generator circuit is used. During the current interval, the current through the test circuit breaker is determined principally by the current-generating circuit, the transformer being connected via a high resistance. Near current zero, however, the conditions are greatly influenced by the voltage-producing circuit. Due to arc voltages, a current is driven through the voltage-producing circuit, causing the arc of the auxiliary circuit breaker to be extinguished before the arc of the test circuit breaker. The time difference between the zeros of the currents through the auxiliary circuit breaker and the test circuit breaker should be limited to a few microseconds and this is done by choosing a high value (of the order of 10^4 ohms) for the resistance R_v. The generator in combination with the transformer forms a typical two-frequency circuit. Usually, however, one frequency is, or can be made, dominant. With residual current present, the transformer voltage circuit has, of necessity, a greater inductance than the direct test circuit. Equation (10) is, therefore, no longer satisfied and the damping of the re-striking voltage is greater than in a direct test. The damping will be even more pronounced by the influence of the resistance R_v, which causes a dividing of the voltage, so that the re-striking voltage of the test circuit breaker will be only part of the voltage of the transformer. This method, therefore, gives correct results only in special cases.

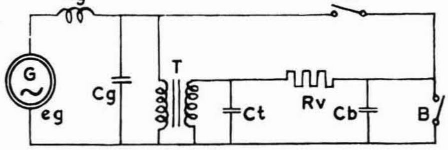

FIG. 6 — TRANSFORMER (T) FOR AMPLIFYING THE RECOVERY VOLTAGE OF THE CURRENT-GENERATING CIRCUIT (G) [During the current interval, the test circuit breaker (B) is connected to the current-generating circuit via an auxiliary circuit breaker (A) and, during the voltage interval, to the voltage-producing circuit via a resistor (R_v)]

Time of interruption

With indirect testing a difficulty is encountered when the time of interruption of circuit breaker in direct test exceeds one half-cycle and these two cases are considered below.

(i) *Interruption in one half-cycle* — If the test power is needed during one half-cycle only, the auxiliary circuit breaker (*A* in Figs. 5 and 6) has to open at the same time as the test circuit breaker and isolate the current-generating circuit at the current zero. In this case one pole of the test circuit breaker may be used as auxiliary circuit breaker. Considering the second indirect test circuit, i.e. the re-striking voltage supplied through a transformer, two things can happen, viz. the arc is not re-struck by this voltage and the circuit is finally interrupted (Fig. 7a); or the circuit breaker is not able to withstand this voltage which is equivalent to non-interruption (Fig. 7b), though in practice the little current supplied by the transformer through the resistance will always be interrupted, since it is much smaller than the nominal current for the circuit breaker, and moreover since it is an ohmic current so easy to interrupt.

(ii) *Interruption in more than one half-cycle* — If testing with more than one half-cycle is required, the conditions become more complicated. After a re-strike in the test circuit breaker, the auxiliary circuit breaker also is to be made to re-strike in order to let pass the short-circuit current for the next half-cycle. This can be done in two ways. Either the voltage across its contacts can be raised until flashover occurs, or its insulation strength can be decreased until the normal re-striking voltage causes flashover.

In the first case, use is made of a high voltage impulse generator. Since the circuit breaker has had sufficient time to deionize effectively before a re-strike is required, it is necessary to have an impulse generator with a high energy content to cause not only a flashover but a real re-strike with follow current in the circuit breaker. Moreover, it should be capable of being re-charged every half-cycle to allow testing with several half-cycles of arcing time. Another drawback is that a high impulse voltage is introduced in the relatively low insulated current-generating circuit and special means must, therefore, be provided to protect it. The advantage of this method is that an ordinary circuit breaker, e.g. one pole of the test circuit breaker, may be used as an auxiliary circuit breaker.

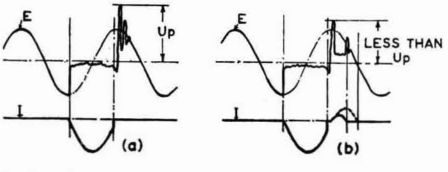

FIG. 7 — CIRCUIT BREAKER INTERRUPTION IN NOT MORE THAN ONE HALF-CYCLE [(a) current finally interrupted; (b) re-strike equivalent to non-interruption; E, voltage supplied by transformer; I, short-circuit current; U_p, maximum peak of the re-striking voltage]

The second arrangement, on account of its effectiveness and reliability, has been used in almost all large-scale indirect tests reported, in spite of the fact that it necessitates a special auxiliary circuit breaker design. The insulation strength is decreased by blowing an auxiliary arc into the space between the contacts. The auxiliary arc may be caused by a surge generator flashing over a spark gap in the circuit breaker. The flashover voltage of the spark gap need not be higher than a few kV. and the discharge current of the order of 100-1000 amp. to cause sufficient ionization. The time needed to re-strike the auxiliary circuit breaker can be kept as short as 100-200 microsec., which is quite sufficient. In the first (synthetic) test circuit considered, the spark gap has to disconnect the surge capacitor so that it could be recharged or exchanged for a charged capacitor, before the voltage has to be injected at the next current zero.

Frequency of re-striking voltage

Re-striking voltage high frequency transients (3000-12,000 c/s.) last for a period of 1000 or 2000 microsec., their exact frequency depending on the R, L and C values of the circuit (Fig. 1). The breaking capacity of a circuit breaker depends on the frequency of the re-striking voltage. Fig. 8, drawn from tests on a small single-phase air-blast circuit breaker of an interrupting capacity of about 1500 amp. at 6·6 kV., shows the variation of symmetrical breaking capacity as a function of the frequency of the re-striking voltage[7]. From curve a, which refers to direct tests, we note that the breaking capacity is almost constant up to about 5000 c/s., and then decreases rapidly. Curve b refers to indirect test with re-striking voltage supplied from the current-generating circuit via a transformer. It is observed that the indirect testing compares very well with direct testing for low frequencies, but not at all at high frequencies. This is due to damping of the re-striking voltage as noticed from cathode-ray oscillographic records. At a frequency of 10,000 c/s. and above, the oscillations are completely damped out. The damping seems to be due to the residual current of the test circuit breaker. Though the residual current is too small to influence the re-striking voltage in a direct test, it is large enough to do so in an indirect test, due to the much greater short-circuit impedance of the voltage-producing circuit in the latter case.

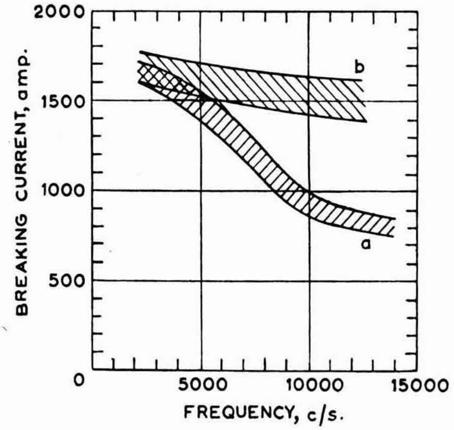

FIG. 8 — BREAKING CAPACITY OF THE TEST CIRCUIT BREAKER AS FUNCTION OF THE FREQUENCY OF THE RE-STRIKING VOLTAGE [(a), direct test and (b), indirect test with re-striking voltage supplied from the current-generating circuit via a transformer; shaded area between boundary lines shows region with both successful and unsuccessful interruptions]

Short-circuit power factor

Short-circuit power factor (p.f.) is also a condition of severity for circuit breaker operation; the lower its value, the easier it is for the arc to re-strike, so that a theoretical case of cos $\phi = 0$ represents the worst conditions. In practice, the lowest values attained are 0·1 for medium voltages (alternator alone) or 0·3 to 0·4 for high voltages (alternator-transformer). Consequently the e.m.f. at zero current value is not E but $0{\cdot}99E$ or about $0{\cdot}95E$ respectively depending on the value of cos ϕ. For a high voltage circuit breaker under direct test the e.m.f. is of the order of $0{\cdot}95E$ (interposition of transformer raises the p.f. to 0·3-0·4); whereas in an indirect test a value of $0{\cdot}99E$ is more appropriate if a suitable circuit is used. The indirect test, in which the re-strking voltage is supplied through a suitable transformer, is similar to the case of an alternator as regards the p.f., since the primary and secondary voltages are almost in opposition, the transformer operating under very low load. Thus the indirect tests are, in fact, more severe and the interruption more difficult than in the case of direct tests.

Conclusion

It is theoretically impossible to obtain full equivalence between direct tests and indirect tests using an installation that produces a short-circuit power lower than the breaking capacity of the circuit breaker under test; and little divergence from the conditions in a direct test have to be accepted if indirect testing shall be possible. However, with suitable circuits, the results obtained from indirect tests are in sufficiently close agreement with the results of comparative direct tests such that indirect tests are considered as equivalent to direct tests under certain conditions.

It is not possible to provide any definite figures for the possible increase in testing power by means of indirect methods, this being a matter of accuracy in determining the breaking capacity; but it is strongly recommended that one should not permit excessive deviations from the conditions of a direct test. The mean difference in arc energy between a direct and an indirect test ought not to be more than 5 to 10 per cent. In addition to the remarkable flexibility possible in indirect testing by a variation of different factors governing the interruption, it permits a great increase in the short-circuit capacity of existing test stations and this is its primary role.

Attempts have been made to replace direct tests for electrical equipment like alternators, transformers, etc., by cheaper indirect methods of testing. The two indirect methods of testing high voltage circuit breakers discussed here give fairly good results.

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Expression of Climate Based on Frequency & Duration of Simultaneously Occurring Dry & Wet Bulb Temperature Ranges

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The conventional method of expressing climatic data as mean maximum or minimum or averages does not show their frequency, duration or ranges, nor their relationship to concurrent phenomena. The double frequency or contingency tables and histograms presented in this paper express the climatic data in a much better manner than the frequency tables of single climatic elements can, and readily indicate the ranges, and frequency and duration of various levels of any two concurrent climatic elements and their interrelationship.

THE climate of different regions of extensive countries like India varies widely. Also, the frequency and duration of given levels of climatic elements and their interrelationship are very different in various localities. Conventional method of expressing climate as average monthly or mean daily maximum or minimum shade dry bulb (d.b.) temperature, with or without wet bulb (w.b.) temperature, may be misleading if the relationship of these averages to their ranges and to those of concurrent climatic elements is not stated. Absolute extremes are often dramatic but misleading if their duration is not appreciated. For example, the climatic conditions in certain places are d.b. temperature, −40°C. (minimum) and wind velocity, 75 km./hr (maximum). The cost of providing adequate protection against such severe conditions will be colossal if it is not realized that combination of such extremes never occurs, and the occurrences of each extreme separately may be few and far between, and of short duration.

The knowledge of the frequency, ranges and duration of the climatic elements and their interrelationship is essential in particular for the physiologist, the bioclimatologist, the health authorities, the biologist, the textile, tanning, brewing and food-packing technologists, the civil and air-conditioning engineers, concrete manufacturers, and the Armed Forces for providing adequate clothing, shelter and fuel, and for inspection and storage of general stores. In the present paper are discussed the preparation and significance of double frequency tables or contingency tables for dry and wet bulb temperatures. Such tables can be prepared for any two climatic elements.

New methods of expressing climatic data

Single frequency tables — The United States Weather Bureau made a frequency distribution study of several climatic elements for the principal cities of U.S.A. for the five-year period 1935-39. From these, Siple[1] realized the great value of frequency data, and he has made a complete analysis of American climates in terms of frequency and duration of temperature, wind velocity, solar radiation and humidity. Recently, the Meteorological Service of the British Royal Navy has prepared climatic frequency tables for different areas of North Atlantic Ocean, which give valuable information. In India, since 1948, self-recording thermohydrographs have been installed at many meteorological stations which are now maintaining records of hourly d.b. temperature and w.b. temperature/relative humidity. The author has made a study of the frequency distribution of d.b. and w.b. temperatures for these stations for a period of five years between 1948 and 1955. The India Meteorological Department is also publishing frequency tables of the d.b. temperature for 18 stations in their *Monthly Weather Review* (*Report*) issued from Calcutta.

The frequency tables of only d.b. temperature give an incomplete picture of climatic conditions in tropical and sub-tropical countries, where w.b. temperature/humidity data are equally important. As regards human comfort, the w.b. temperature becomes important when d.b. temperature rises above 70°F., and becomes all important when d.b. temperature exceeds 93°F. These climatic elements can be expressed best as contingency tables or double thermal histograms. Burton[2] also has emphasized the importance of the double frequency tables, giving analysis of correlation of one concurrent climatic element with the other.

Double frequency tables and histograms — The double frequency or contingency tables are statements of ranges, and frequency and duration of various levels of any two concurrent climatic elements and their interrelationship.· For the construction of these tables, records of one-hourly dry and wet bulb temperature for five years between 1948 and 1955 were obtained from meteorological stations having self-recording thermohydrographs. Then average temperature of each hour of corresponding time and date for five years was taken and designated as five years' average one-hourly temperature. Thus the temperature given for, say 0900 hrs on 1 January represents average temperature for that hour in January over five years. Similar averages of every third hour were taken and designated as five years' average three-hourly temperature. Five years' average temperature at any hour was taken as that usually prevailing at that time. For demonstrating the construction of contingency tables, it was assumed that each temperature reading represented the temperature prevailing during the succeeding one-hour/three-hour period. For preparing accurate tables, average temperature for each one-hourly/three-hourly period may be determined.

The contingency tables may be computed from any five years' average one-hourly or three-hourly d.b. and w.b. temperature data. Ideally, they should be prepared from the one-hourly fluctuations of the climatic elements and taking one degree unit for temperature. But it is beyond human ability to discriminate changes in temperature by units of one degree Fahrenheit. Human ability to discriminate small changes in temperature increases as the ambient temperature comes nearer the skin temperature, and when the ambient temperature exceeds that of the skin, a rise in even 2°F. of temperature or 1 per cent of relative humidity may be felt. Hence a bigger unit of 5°F. may be used in preparing the tables. To construct the tables, horizontal and vertical columns are drawn and 5°F. range is allotted to both d.b. temperature (along the horizontal columns) and w.b. temperature/R.H. (along vertical columns, or vice versa). Then d.b. and w.b. temperatures of corresponding hours from the five years' average one-hourly or three-hourly temperature tables are taken, and an entry is made for this combination in the appropriate intersection block of dry and wet bulb temperatures. Figures in each block give the number of hours for which that particular level of climatic elements has occurred during the period for which the table has been prepared. The figures in each horizontal and vertical column are totalled up, and proportion of the period in each horizontal and vertical column to the whole period under consideration is calculated, and expressed as percentages. There is no sharp boundary between the 5°F. zones. For allotting to appropriate zones, the temperatures are corrected to the nearest degree Fahrenheit.

The reliability of temperature values used in making contingency tables, computed from frequency data for five years only, was established by the fact that the monthly average mean of daily maximum and minimum temperatures computed from five years' one-hourly data for some months, selected at random for 10 stations, was found, on comparison, to coincide with 50 years' average monthly temperature of corresponding months.

In northern and central India three well-defined seasons prevail: November to February — cold-dry; March to June — hot-dry; and July to October — warm-wet. In the Deccan peninsula the rainy season starts early and advances the other seasons. Also, there is no well-defined cold season and interseasonal and intraseasonal temperature ranges are smaller than in the northern and central regions. Therefore, four-monthly contingency tables or double thermal histograms would conveniently give a seasonal picture of climatic conditions, while the monthly tables/histograms convey a more complete picture and incidentally also reflect daily cycles.

The Tables 1-4 give the full range of temperatures, but the range which prevails most of the time, i.e. more than 50 per cent of the period under consideration, may logically be taken to represent the climatic conditions prevailing in the given period, say a month or a four-month season. Four-monthly and yearly contingency tables of d.b. and w.b. temperatures for New Delhi are given in Table 1. It has also been seen that contingency tables prepared from one-hourly fluctuation of temperature are not much different from those computed from three-hourly fluctuations. The information furnished by both is almost the same, as shown by sets of monthly and four-monthly contingency tables for Poona based on hourly and three-hourly fluctuation of temperature (Tables 2-4). In all the tables the ranges demarcated by heavy lines show the climatic conditions prevalent most of the time during the period under consideration.

The frequency relationship of concurrent climatic phenomena can also be presented more vividly by their histographic profile, which may be called double

TABLE 1 — CONTINGENCY

Dry bulb temp. °F.	Wet bulb														
	Nov.-Feb.						March-June						July-		
	41-45	46-50	51-55	56-60	61-65	%	56-60	61-65	66-70	71-75	76-80	%	56-60	61-65	66-70
106-110										6	2	0·8			
101-105								2	27	62	17	11·1			
96-100								7	35	53	41	13·9			
91-95								19	45	59	22	14·8		2	12
86-90					6	0·6	2	33	48	35	26	14·7		19	9
81-85				14	10	2·5	14	82	56	11	5	17·2	1	9	16
76-80				38	14	5·4	7	51	14			7·4		9	28
71-75			33	73	3	11·4	30	44				7·6	2	23	30
66-70	1		78	55	3	14·3	55	18				7·5	4	20	1
61-65		3	94	46		14·9	44					4·5	7	4	
56-60	2	14	154	8		18·5	4					0·4			
51-55	2	119	84			22·3									
46-50	3	93				10·0									
41-45	1					0·1									
%	0·8	25·0	45·9	24·5	3·8		16·0	26·2	23·0	23·2	11·6		1·4	8·7	9·8

TABLE 2 — THREE-HOURLY MONTHLY

Dry bulb temp. °F.	Wet bulb																						
	Jan.					Feb.					March					April				May			
	51-55	56-60	61-65	66-70	%	46-50	51-55	56-60	61-65	%	51-55	56-60	61-65	66-70	%	61-65	66-70	71-75	%	61-65	66-70	71-75	%
101-105																	3	5	3·3		1	5	2·4
96-100									3	1·3			7	15	8·9		27	9	15·0		14	23	14·9
91-95								2	15	7·6			33	19	21·0	1	38	5	18·3		3	35	15·3
86-90			23	3	10·5			12	24	16·1			19	—	7·6	1	6	3	4·2		9	15	9·7
81-85			43	4	19·0			19	5	10·7			18	3	8·5	6	41	1	20·0		26	26	21·0
76-80		1	19		8·1		1	5	4	4·5		7	17		9·7	15	27		17·5	2	27	27	22·6
71-75		2	13		6·0		2	25	4	13·9		27	22		19·7	31	10		17·1	7	24	3	13·7
66-70		21	9		12·1		17	16		14·7		32	3		14·1	11			4·6	1			0·4
61-65	12	49	1		25·0		32	8		17·9	3	23			10·5								
56-60	16	21			14·9	3	21	1		11·1													
51-55	11				4·4	4	1			2·2						1							
Total	39	94	108	7	248	7	74	88	55	224	3	89	119	37	248	65	152	23	240	10	104	134	248
%	15·7	37·9	43·6	2·8		3·1	33·0	39·3	24·6		1·2	35·9	48·0	14·9		27·1	63·3	9·6		4·0	42·0	54·0	

TABLE 3 — ONE-HOURLY MONTHLY

Dry bulb temp. °F.	Wet bulb																						
	Jan.					Feb.					March					April				May			
	51-55	56-60	61-65	66-70	%	46-50	51-55	56-60	61-65	%	51-55	56-60	61-65	66-70	%	61-65	66-70	71-75	%	61-65	66-70	71-75	%
101-105																	10	10	2·8		7	12	2·6
95-100									6	0·9			27	37	8·6		95	34	17·9		30	76	14·2
91-95								6	58	9·5			90	45	18·1	3	81	8	12·8		23	85	14·5
86-90			77	13	12·0			38	45	12·3			63	9	9·7	11	58	10	11·0		28	65	12·5
81-85			102	6	14·5			51	20	10·6		7	70	9	11·6	9	94	6	15·1		50	60	14·8
76-80		14	51		8·7		5	47	9	9·1		12	63	2	10·3	39	77		16·1	6	102	100	28·0
71-75		28	56		11·3		9	67	6	12·2		45	50		12·8	106	38		20·0	18	71	8	13·0
66-70		68	30		13·2		30	49		11·8	1	104	12		15·7	31			4·3	3			0·4
61-65	12	107	2		16·3		85	20		15·6	9	89			13·2								
56-60	63	78			19·0	23	76	1		14·9													
51-55	37				5·0	19	2			3·1													
Total	112	295	318	19	744	42	207	279	146	672	10	257	375	102	744	199	453	68		27	311	406	
%	15·0	39·7	42·7	2·6		6·2	30·7	41·5	21·6		1·3	34·6	50·4	13·7		27·6	62·9	9·5		3·6	41·8	54·6	

TABLE 4 — FOUR-MONTHLY

Dry bulb temp. °F.	Wet bulb																
	One-hourly																
	Nov.-Feb.						March-June							July-Oct.			
	46-50	51-55	56-60	61-65	66-70	%	51-55	56-60	61-65	66-70	71-75	76-80	%	66-70	71-75	76-80	%
101-105										17	22		1·3				
96-100				6		0·2			27	162	110		10·2				
91-95			6	58		2·2			93	149	121	9	12·7	5	2	1	0·3
86-90			38	155	81	9·5			74	95	152	2	11·0	12	130	28	5·8
81-85			51	303	96	15·6		7	79	153	228		16·0	11	362	38	13·9
76-80		5	73	160	39	9·6		12	108	181	368		22·8	40	719	6	25·9
71-75		9	117	178	23	11·4		45	174	109	182		17·5	362	1076		48·7
66-70		30	186	199	3	14·5	1	104	46				5·2	160			5·4
61-65		107	327	91		18·2	9	89					3·3				
56-60	23	216	200			15·2											
51-55	19	81				3·5											
Total	42	448	998	1150	242		10	257	601	866	1183	11		590	2289	73	2952
%	1·5	15·6	34·6	39·9	8·4		0·3	8·8	20·5	29·6	40·4	0·4		20·0	77·5	2·5	

TABLES: NEW DELHI

TEMP., °*F.*

Oct.				Jan.-Dec.										DRY BULB TEMP. °*F.*
71-75	76-80	81-85	%	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	%	
										6	2		0·27	106-110
								2	27	62	17		3·7	101-105
	10	1	1·1					7	35	53	51	1	5·0	96-100
38	68	14	13·6					21	57	97	90	14	2·5	91-95
46	191	17	18·7				2	58	57	81	217	17	14·8	86-90
60	239	8	33·8				29	101	72	71	244	8	18·0	81-85
59	37		13·5				45	74	42	59	37		8·8	76-80
			5·6			33	105	70	30				8·1	71-75
			2·5			78	114	41	1				8·0	66-70
			1·1	1	3	94	97	4					6·8	61-65
				2	14	15	12						6·2	56-60
				2	128	82							7·3	51-55
				3	86								3·3	46-50
				1									0·03	41-45
20·6	55 4	4·1		0·3	7·9	15·3	13·9	12·9	11·0	14·7	22·5	1·4		%

CONTINGENCY TABLES: POONA

TEMP., °*F.*

June			July		Aug.			Sept.			Oct.				Nov.				Dec.				DRY BULB TEMP. °*F.*
71-75	76-80	%	71-75	%	66-70	71-75	%	66-70	71-75	%	66-70	71-75	76-80	%	56-60	61-65	66-70	%	51-55	56-60	61-65	%	
																							101-105
																							96-100
10	3	5·4									3	1	1	2·0									91-95
27	1	11·7	7	2·8					11	4·6	4	26	7	14·9		6	18	9·9			9	3·7	86-90
53		22·1	28	11·3		19	7·7	1	51	25·7	2	27	12	16·6		10	34	18·4			38	15·3	81-85
92		38·3	86	84·7		86	34·7	12	43	22·9	3	29	2	13·7		7	18	10·4		1	45	18·5	76-80
54		22·5	127	51·2	30	113	57·6	78	31	45·4	17	75		37·1		22	7	12·1					71-75
								13		5·4	39			15·7	7	52		24·7		23	13	14·5	66-70
															20	30		20·8	10	50	1	24·6	61-65
															9			3·7	19	28		18·9	56-60
																			11			4·5	51-55
236	4	240	248	248	30	218	248	104	136	240	68	158	22	248	36	127	77	240	40	102	106	248	Total
98·3	1·7		10·0		12·1	87·9		43·1	56·7		27·4	63·7	8·9		14·8	52·9	32·3		16·0	41·2	42·8		%

CONTINGENCY TABLES: POONA

TEMP., °*F.*

June			July		Aug.			Sept.			Oct.				Nov.				Dec.				DRY BULB TEMP. °*F.*
71-75	76-80	%	71-75	%	66-70	71-75	%	66-70	71-75	%	66-70	71-75	76-80	%	56-60	61-65	66-70	%	51-55	56-60	61-65	%	
																							101-105
																							95-100
28	9	5·1									5	2	1	1·1									91-95
77	2	11·0	17	2·0					32	4·4	12	81	28	16·3		10	68	10·9			23	3·1	86-90
162		22·5	28	12·0		56	7·5	4	150	21·4	7	68	38	15·3		33	90	17·1			148	19·9	81-85
268		37·2	245	33·0		245	32·9	26	132	22·0	14	97	6	15·4		40	39	11·0		12	60	9·7	76-80
174		24·2	394	53·0	87	365	59·6	240	100	47·2	35	226		35·2	1	72	23	13·3		21	44	8·7	71-75
								36		5·0	124			16·7	10	139	3	21·1		59	30	12·0	66-70
															72	88		22·2	10	128	1	18·7	61-65
															32			4·4	77	89		22·3	56-60
																			42			5·6	51-55
709	11		744		87	657		306	414		197	474	73		115	382	223		129	309	306		Total
98·5	1·5		100		11·7	88·3		42·5	57·5		26·5	63·7	9·8		16·0	53·0	31·0		17·3	41·5	41·2		%

CONTINGENCY TABLES: POONA

TEMP., °*F.*

Three-hourly																	DRY BULB TEMP. °*F.*
Nov.-Feb.						March-June							July-Oct.				
46-50	51-55	56-60	61-65	66-70	%	51-55	56-60	61-65	66-70	71-75	76-80	%	66-70	71-75	76-80	%	
									4	10		1·4					101-105
			3		0·3			7	56	32		9·7					96-100
		2	15		1·8			34	60	50	3	15·1	3	1	1	0·5	91-95
		12	62	21	9·9			20	15	45	1	8·3	4	44	7	5·6	86-90
		19	96	38	15·9			24	70	80		17·8	3	125	12	14·2	81-85
	1	9	71	18	10·3		7	34	54	119		21·9	15	244	2	26·5	76-80
	2	27	39	7	7·8		27	60	34	57		18·2	125	346		47·9	71-75
	17	67	74		16·5		32	15				4·8	52			5·3	66-70
	54	127	32		22·2	3	23					2·7					61-65
5	56	59			12·5												56-60
4	23				2·8												51-55
9	153	322	392	84		3	89	194	293	393	4		202	760	22		Total
0·9	16·0	33·5	40·8	8·8		0·3	9·1	19·9	30·0	40·3	0·4		20·5	77·2	2·2		%

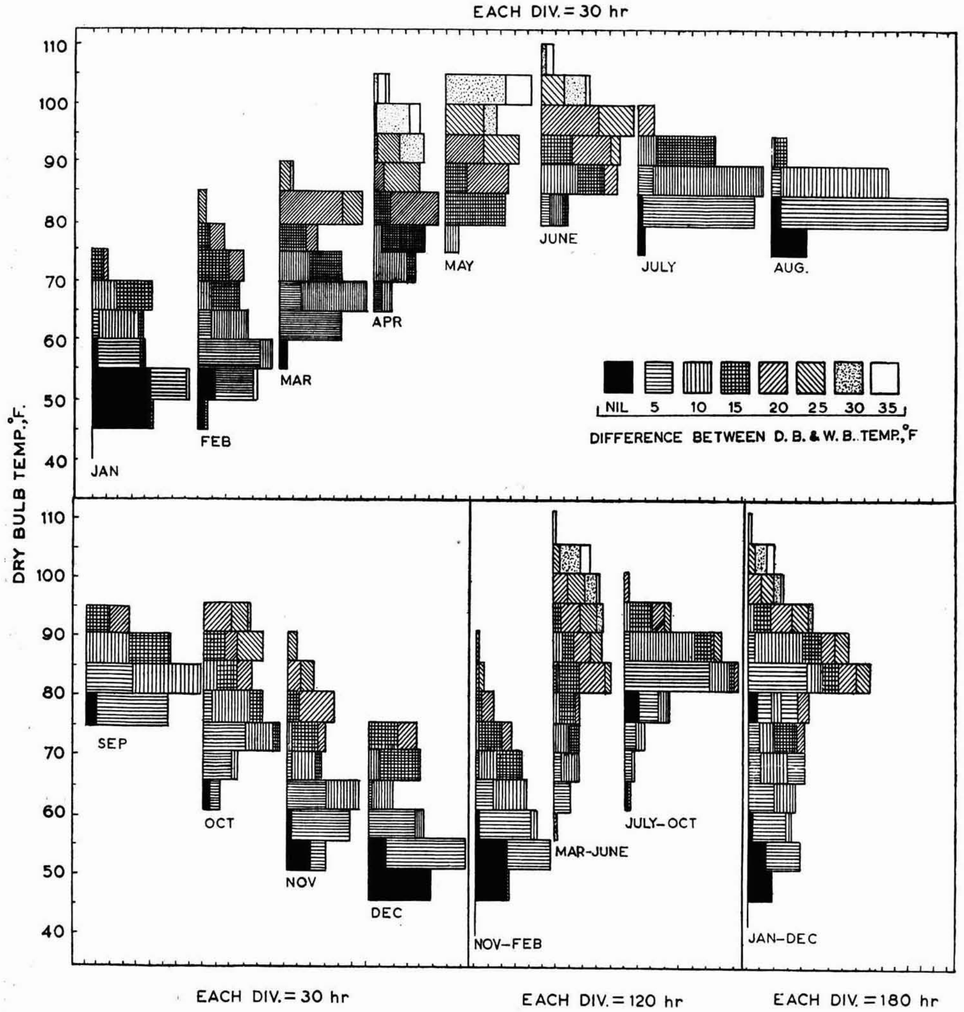

FIG. 1 — MONTHLY, FOUR-MONTHLY AND YEARLY DOUBLE FREQUENCY THERMAL HISTOGRAMS OF D.B. TEMPERATURE WITH TEMPERATURE DIFFERENCE BETWEEN DRY AND WET BULBS

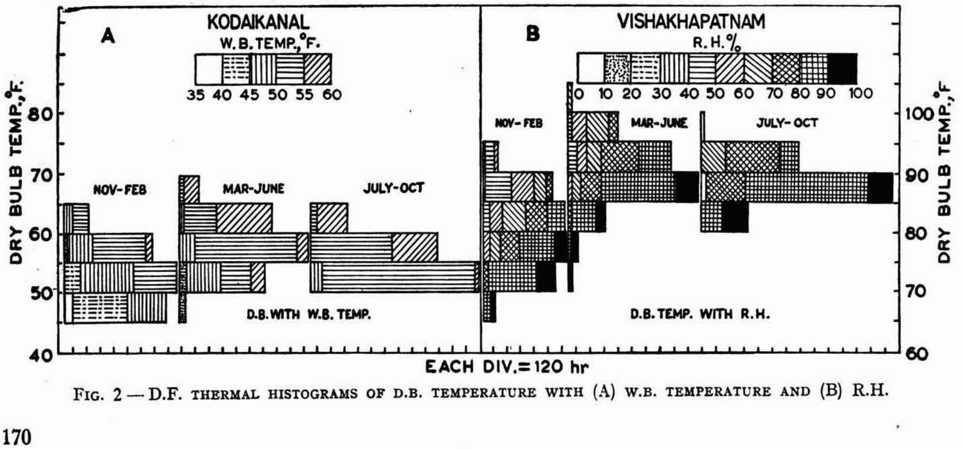

FIG. 2 — D.F. THERMAL HISTOGRAMS OF D.B. TEMPERATURE WITH (A) W.B. TEMPERATURE AND (B) R.H.

thermal histograms, and are prepared from contingency tables. Such histographic profiles are shown in Figs. 1 and 2 where each division on the abscissae represents 30 hr in monthly, 120 hr in seasonal and 180 hr in yearly graphs, and on the ordinates is marked temperatures in 5°F. intervals. The length of the column of the histogram depicts the duration of given d.b. temperature. The w.b. temperatures occurring during that period are superimposed by differential hatching. Such a thermal histogram clearly shows the fluctuations and duration of w.b. temperature which occur in any zone of d.b. temperature. The monthly, four-monthly and yearly thermal histograms for New Delhi given in Fig. 1 show presentation of d.b. temperature with humidity in terms of difference between dry and wet bulb temperatures, so that zero difference represents 100 per cent R.H. and for every 1°F. difference reduce R.H. by 3·5 per cent. The mode of presentation of d.b. with w.b. temperature, and d.b. temperature with relative humidity is shown in four-monthly thermal histograms for Vishakhapatnam and Kodaikanal given in Fig. 2 (A and B respectively).

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Chromate Treatment of Zinc & Other Metals: Part I — Accelerated Testing of Chromate Coatings

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The protection afforded by chromate coatings to zinc under different atmospheric conditions has been studied and a new method of testing chromate coatings is proposed. Studies on temperature and humidity conditions under which the chromate coating formed by Cronak process gives protection show that in the presence of salt spray the temperature at which the test is carried out is an important variable in determining the efficiency of protection of chromate coating.

AN increasingly prominent place among the chemical surface treatments used by the metal industry is coming to be occupied by chromate treatments[1,2]. Chromate coatings are applied to a number of non-ferrous metals like zinc, cadmium, aluminium, magnesium and copper alloys. This method, however, finds its widest application with zinc and zinc alloys for the reason that among the various non-ferrous metals in commercial use, zinc and its alloys are most susceptible to what is known as ' white rust ' formation. White rust is the bulky white corrosion product formed on zinc when it is exposed to highly humid atmospheres or subjected to atmospheric conditions in which copious condensation of moisture on the metal specimen can take place[3]. Such conditions are frequently met with in the tropics and chromate conversion coatings were, therefore, widely used during World War II for the protection of zinc-plated parts in tropical service. It may, therefore, be expected that this method of protection of zinc plates and zinc alloys will come to be more and more widely used by the metal industries in this country. This development, it is believed, will be facilitated by an investigation into the bath compositions suitable for use in the tropics especially since the great majority of processes now in use in the West are proprietary processes. The results of an investigation into the temperature and humidity conditions under which chromate coating on zinc formed by the Cronak process gives protection in laboratory tests, are presented in this paper. The Cronak process has been chosen for the present study as the process details are known and the process is even now one of the most widely used processes for coating zinc. The information thus obtained may be made use of in the testing of new formulations under climatic conditions prevailing in this country.

Experimental procedure

Zinc of commercially pure quality was used. Pieces (3 × 2 in. and 3 × 1 in.) were cut, abraded with 0 emery paper, degreased with benzene, acetone and methanol and immersed in a bath containing 182 g./litre of potassium dichromate and 6 ml./litre of sulphuric acid (Cronak composition)[4] at room temperature (30°C.) for 10 sec. The weight of film formed was 15 ± 1 mg./sq. dm. in all cases. After treatment, the specimens were rinsed with cold water and dried at room temperature and subjected to test.

The time of first appearance of white corrosion product and the loss in weight of the specimen after cleaning it free of corrosion product with 20 per cent chromic acid[5] solution at 80°C. for 1 min. were noted and the failure of the coating thus evaluated. In the case of chromate-treated metal, the weight of chromate coating was deducted from the total loss in weight. The specimens were suspended in 500 ml. bottles by means of $\frac{1}{2}$ in. long waxed nichrome wire hooks over distilled water or sulphuric acid solution maintaining the desired humidity. Each experiment was carried out with duplicate specimens and the mean value recorded. To obtain corrosion-time curves, several bottles were simultaneously set up and the experiment terminated at the end of different test periods. The mean value did not differ from the individual values by more than 10 per cent in all the tests. The experiments at elevated temperatures were carried out in incubators maintained within ±0·5°C.

Results and discussion

Performance of chromate coatings at humidities ranging from 85 *to* 100 *per cent at different temperatures* — It is reported in the literature on Cronak process that it gives good protection up to 200°F. under high humidity and moisture condensation conditions[6]. But precise data either on the accelerating effect of humidity or of temperature are lacking. The performance data of chromate-treated zinc between 30° and 60°C. and 80 and 100 per cent R.H. in steps of 10°C. and 5 per cent R.H. are given in Table 1.

It is seen from the results given in Table 1 that corrosion of untreated zinc steadily increases with increase in humidity which shows that the extent of moisture condensation on the metal surface is the principal factor promoting corrosion. The extent of corrosion of zinc at 100 per cent R.H. is 3-4 times that at 85 per cent at all temperatures. Increase in temperature accelerates corrosion of zinc up to 50°C. after which it falls; this may by due to the fall in the amount of oxygen dissolved in the moisture film above 50°C. The time of first appearance of rust, which is often used as a criterion of failure[7] of chro-

TABLE 1 — PERFORMANCE OF CHROMATE COATING

(*Test period*, 30 *days*)

R.H. %	CONDITION OF METAL	TIME OF FIRST APPEARANCE OF RUST AT (*days*)				LOSS IN WEIGHT AT (*mg./sq. dm.*)			
		30°C.*	40°C.	50°C.	60°C.	30°C.*	40°C.	50°C.	60°C.
85	A	7	5	5	5	12·0	18·0	21·0	19·0
	B	>30	>30	20	28	1·6	1·6	5·5	4·2
90	A	4	2	1	1	17·0	34·0	42·0	37·0
	B	>30	28	18	25	2·6	4·0	12·5	7·0
95	A	4	2	1	1	22·0	43·0	58·0	50·0
	B	28	25	15	20	3·6	6·2	18·0	10·0
100	A	3	2	1	1	35·0	52·0	88·0	87·0
	B	25	17	12	15	6·0	9·3	14·0	11·0

A, untreated; B, chromated.
*Room temperature.

mate coating, is the same for samples kept at 90 per cent R.H. and 40°C. and those kept at higher humidities and temperatures in the case of untreated zinc. Chromate treatment gives almost complete protection up to 90 per cent R.H. below 50°C. At higher humidities (95 and 100 per cent), a slight decrease in the degree of protection is, however, observed, especially when higher temperatures are maintained.

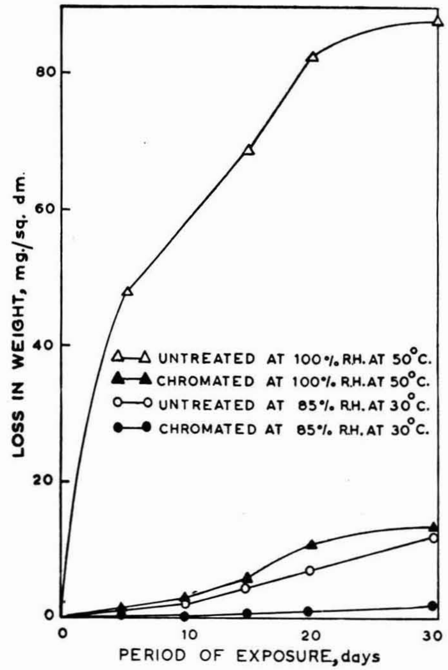

FIG. 1 — CORROSION-TIME CURVES AT HIGH HUMIDITIES

The corrosion-time curves of untreated and chromate-treated zinc at room temperature and 85 per cent R.H. and at 50°C. and 100 per cent R.H. are presented in Fig. 1. From the linear or parabolic relationship of the curves it is concluded that the period of test is of sufficiently large duration for obtaining a true picture of the behaviour of the chromate coating.

Spray and immersion tests — The part played by salt present on the metal surface at 100 per cent R.H. has been studied by the A.R.E. salt spray test[8] in which the salt solution is sprayed on the metal surface exposed to 100 per cent R.H. once a day. The results obtained with untreated and chromate-treated zinc when sprayed with 0·1, 1 and 3 per cent salt solutions at different temperatures are recorded in Table 2 along with the results obtained in immersion tests at 100 per cent R.H. alone.

The results in Table 2 show that the appearance of rust on chromate-treated specimens is earlier with a spray of 0·1 per cent salt solution at room temperature than what is observed with specimens kept at 50°C. without spray. The rate of corrosion of untreated zinc is accelerated by 6 times by spraying with 0·1 per cent salt solution; increase in salt concentration from 0·1 to 3 per cent accelerates the corrosion rate by 2 times. At 0·1 per cent salt concentration, chromate coating gives appreciable protection at elevated temperatures as in the case of high humidity alone. But at 1 per cent salt concentration, a sharp decrease in the protective efficiency of the chromate treatment is noticed even at 40°C. This is further enhanced at 50°C. At 3 per cent concentration, the corrosion of the treated metal is one-tenth of that of untreated metal at room temperature while at 50°C. it corrodes practically at the same rate as the

TABLE 2 — BEHAVIOUR OF CHROMATE COATING IN SPRAY AND IMMERSION TESTS

(*Test period*, 300 *hr*)

TEST	CONDITION OF METAL	TIME OF FIRST APPEARANCE OF RUST (*hr*) AT				LOSS IN WT (*mg./sq. dm.*) AT			
		30°C.	40°C.	50°C.	60°C.	30°C.	40°C.	50°C.	60°C.
No spray*	A	72	48	24	24	35	52	88	87
	B	600	648	288	360	6	9·3	14	11
Sprayed daily with 0·1% salt solution	A	12	5	5	5	198	213	266	216
	B	192	96	72	72	22	28	55	80
Sprayed daily with 1% salt solution	A	6	4	4	4	234	260	323	374
	B	192	96	72	48	37	140	270	261
Sprayed daily with 3% salt solution	A	6	4	4	4	427	453	551	479
	B	192	96	72	48	37	193	450	419
Immersion test, 1%	A	—	—	—	—	229	269	457	440
	B	—	—	—	—	94	102	119	124
Immersion test, 3%	A	—	—	—	—	244	282	534	632
	B	—	—	—	—	158	168	192	220

A, untreated; B, chromated.
*Test period was 30 days (taken from Table 1).

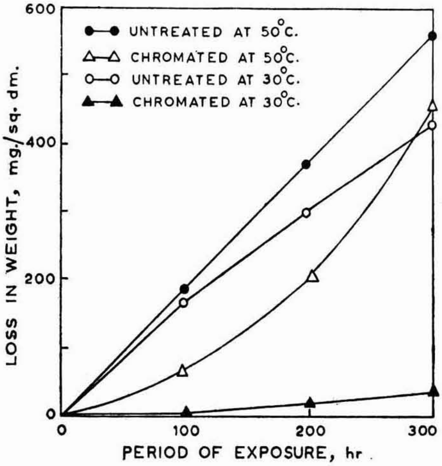

FIG. 2 — EFFECT OF TEMPERATURE ON CHROMATE COATING IN 3 PER CENT A.R.E. SALT SPRAY TEST

untreated metal. On the other hand, in immersion tests, the untreated metal corrodes very rapidly but the extent of corrosion of chromated metal is kept at a fairly low figure by the hexavalent chromium leached into the solution. The corrosion-time curves of treated and untreated zinc at 50°C. and room temperature when sprayed with 3 per cent salt solution are presented in Fig. 2. These curves show that while the corrosion of untreated zinc at 30° and 50°C. and of treated zinc at 30°C. is proportional to time, rapid breakdown is indicated by the corrosion rate increasing sharply with time in the case of the chromate-treated metal at 50°C.

Effect of humidity on 3 per cent salt spray test — In Table 3 are recorded the results of a study on the effect of humidity in 3 per cent salt spray test at the various temperatures studied. The results given in Table 3 confirm the earlier observation that increase of temperature from 30° to 40°C. brings about a very marked decrease in the protective efficiency of chromate coatings and that at 50°C. the chromate treatment hardly gives any protection. Humidity alone has very little action as compared to salt spray.

Comparison of different tests for chromate treatment — Various accelerated tests have been used for evaluating the protective action of chromate coatings. It was, therefore, of interest to study the behaviour of chromate coating obtained in the Cronak process in different tests. The results obtained with the conventional salt spray test to A.S.T.M. standards[9], and with the steam test[10] and the aerosol corrosion test[11] are presented graphically in Figs. 3 and 4 respectively. The data obtained in Armaments Research Establishment (A.R.E.) salt spray test at 50°C. are also included for comparison. It is clear from Figs. 3 and 4 that in the case of all the tests other than the A.R.E. salt spray test at 50°C. the loss in weight is very much less in the case of treated specimens as compared to untreated metal. In the case of the conventional salt spray test, the rate of corrosion of *untreated* metal is greater than in the A.R.E. salt spray test and yet the *treated* metal gives a lower corrosion rate, thus pointing out the important role played by temperature in the breakdown of the coating. The conventional salt spray test does not

TABLE 3 — EFFECT OF HUMIDITY IN SALT SPRAY TEST

R.H. %	CONDITION OF METAL	LOSS IN WT (*mg./sq. dm.*) AT			
		30°C.	40°C.	50°C.	60°C.
85	A	400	424	485	452
	B	33	265	388	378
90	A	413	438	470	461
	B	36	277	402	387
95	A	420	445	491	468
	B	37	285	413	397
100	A	427	453	557	479
	B	37	293	450	419

A, untreated; B, chromated.

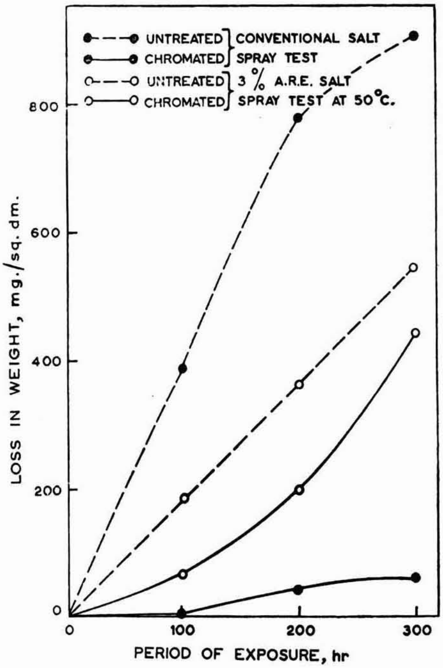

FIG. 3 — CORROSION-TIME CURVES FOR UNTREATED AND CHROMATE-TREATED ZINC IN CONVENTIONAL AND 3 PER CENT A.R.E. SALT SPRAY TEST METHODS

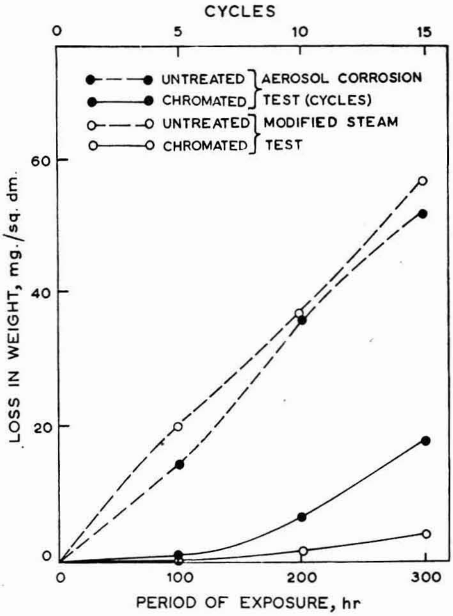

FIG. 4 — CORROSION-TIME CURVES FOR UNTREATED AND CHROMATED ZINC IN AEROSOL CORROSION AND MODIFIED STEAM TESTS

lend itself easily to determinations at different temperatures. In the case of the steam test, although the temperature of the coating is raised considerably no failure of the coating is observed and satisfactory results are obtained. This is also expected from the results of tests on the effect of humidity alone on corrosion rate (Table 1). In the aerosol corrosion test, in which both a salt fog as in conventional salt spray test and a heating cycle (10 min. of heating in each hour) are employed, the corrosion-time curve shows an upward trend towards the end of the curve. The difference in the corrosion rate of chromate-treated zinc and the untreated zinc is less under the conditions of this test than in the salt spray or steam tests. The effect of temperature is strikingly brought out by 3 per cent A.R.E. salt spray test carried out at elevated temperatures. The A.R.E. salt spray test has the advantage of being easily manipulated at different temperatures and humidities thus enabling accelerated testing of chromate treatment under climatic conditions obtaining at different places in the tropics.

From the above study, it is concluded that chromate coating gives satisfactory protection under high humidity conditions and that the protection is maintained to a considerable extent even at salt concentrations up to 3 per cent at temperatures below 35°C. In the presence of salt, a rise in temperature has an adverse effect. Chromate coatings are likely to suffer rapid breakdown under temperatures (above 35°C.) met with in coastal areas in the tropics. Hence, large-scale users of chromate treatment in such places, e.g. G.I. mills and producers of die-cast zinc parts and electrical items, would do well to assess the behaviour of proprietary formulations at elevated temperatures also by means of the A.R.E. salt spray test or any similar test which takes into account the atmospheric temperature of the destinations to which the treated metal will be sent.

Acknowledgement

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Chemical Stabilization of Sand: Part I—Stabilization of Sand Embankments

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A simple technique of stabilizing the surface sand of sandy embankments and sand dunes has been developed which consists in spraying dressed and compacted sandy layer first with sodium silicate solution, drying, and finally spraying with calcium chloride solution. Layers of sand stabilized in this manner are hard and possess adequate hydraulic strength.

THE conventional method employed in the stabilization of a bank of natural stream or an artificial channel is by the use of stone. In the case of certain hill torrents only coarse sand is available in their beds and in such cases it is neither economical nor practicable to use stone. Therefore, an attempt was made to see how far Joosten's[1] procedure could be employed with certain modifications.

Joosten succeeded in stabilizing loose sand in foundation with alternate injections of sodium silicate and calcium chloride solutions. Calcium silicate formed by the reaction between the two chemicals fills up the pores in the sand strata, producing an impermeable, dense and hard gel. In order to cement unconsolidated sand bed beneath building and dam foundations[2], hydrated calcium silicate gel is produced by pumping 35 per cent water glass solution and 33 per cent calcium chloride solution alternately in small amounts from separate pipes. This method of chemical grouting[3] is universally used for consolidating porous deep foundations and rendering them impervious to water. One of the authors (H.L.U.), in 1955, contacted in London the chemical grouting specialist of John Mowlem & Co. Ltd, who affirmed that sodium silicate and calcium chloride had never been utilized for surface sand stabilization and it would be worth while developing a method for this purpose[4].

Experimental procedure

Sodium silicate used for the following studies had the following composition — $NaO_2 : SiO_2 :: 1 : 2$.

The following studies were carried out to develop a suitable method of stabilizing surface sand.

Alternate injection of sodium silicate and calcium chloride — Sodium silicate solution of 10, 20, 30 and 40 per cent concentration and equivalent strength solution of calcium chloride were injected alternatively into a sand column. This process mostly affected the replacement of the previously injected solution. The solution of higher concentration had better effect in making the sand impervious and dense, but the sand did not harden on drying or on curing in a humidity chamber, even after one month.

Mixing sodium silicate and calcium chloride with sand — Sodium silicate solution of 10, 20, 30 and 40 per cent concentration and equivalent percentage of calcium chloride in solution were mixed with sand and briquettes were formed. The briquettes did not exhibit any strength either on drying or curing in a humidity chamber. It was observed that sand could be made dense and impervious by the above two methods but the treated mass does not develop any hydraulic strength.

Drying compacted mixture of sand and sodium silicate at about 100°C. — Sand can be stabilized by mixing with such a concentration of sodium silicate which would form a cohesive mass (i.e. 22·5 per cent minimum concentration), and drying at 100°C.; the stabilized mass of sand did not soften easily in water. This heat treatment method is difficult to adopt in the field. Stabilization is not expected to last long when the stabilized mass of sand is subjected to the action of running water. Hence this method is not of much practical utility.

Impregnation of sand and sodium silicate mixture with calcium chloride — Sand when mixed with a solution of sodium silicate forms a uniformly cohesive mass on drying, which, however, remains porous. But when it is dried in the sun and then impregnated with calcium chloride solution, it becomes hard and resistant to the softening action of water. This method is considered to be of practical utility because the technique could be conveniently applied in the field.

For standardization of this method the following investigations were carried out.

Concentration of sodium silicate required to make sand uniformly cohesive — Three types of sand of fineness modulus (F.M.) 0·73, 1·10 and 1·58 were selected. Pellets of the sands were compacted after mixing it with 20 per cent sodium silicate solution on the weight of the sand. The concentrations of sodium silicate solution employed were 7·5, 11, 15, 18·5, 22·5, 30 and 37·5 per cent. The mixture was dried at 50°C. for 24 hr. The dried pellets, cut at centre and examined, showed that sodium silicate solution of 22·5 per cent or more concentration gives uniform cementing action.

Quantity of calcium chloride required for stabilization — Dried briquettes of sand compacted with 22·5 per cent sodium silicate solution were soaked in calcium chloride solutions of various concentrations. The briquettes when soaked in water disintegrated but when soaked in 2 per cent calcium chloride solution, they exhibited swelling and formation of a few cracks. Use of 5 per cent or higher concentrations of calcium chloride solution imparted only an apparent stabilizing effect on the briquette.

TABLE 1 — EFFECT OF CALCIUM CHLORIDE CONCENTRATION ON BRIQUETTE STRENGTH

(*Test briquettes soaked in different concentrations of calcium chloride solution for* 24 *hr*)

TREATMENT	TENSILE STRENGTH *lb./sq. in.*
Dry briquette	365·0
Soaked in water	nil
Soaked in 2% $CaCl_2$ solution	nil
Soaked in 5% $CaCl_2$ solution	63·5
Soaked in 10% $CaCl_2$ solution	71·7
Soaked in 15% $CaCl_2$ solution	101·0
Soaked in 20% $CaCl_2$ solution	103·0

The briquettes were prepared using 20% sodium silicate solution (strength, 22·5%) on the weight of sand and dried for 24 hr at 50°C. before treatment.

To determine the extent of stabilization taking place when briquettes are treated with calcium chloride solution, the tensile strength of the treated briquettes was determined. The results are given in Table 1.

From the results given in Table 1 it could be inferred that sodium silicate and sand mixture exhibits very high drying strength but the same mix exhibits no strength on wetting. There was a sharp increase in briquette strength with increasing concentration of calcium chloride in the wet condition. For economic stabilization of sand by this method, the use of 15 per cent calcium chloride solution appears to be necessary.

Durability of sodium silicate and calcium chloride stabilized sand in running water — The durability of sand compacted with 22·5 per cent sodium silicate solution and treated with 15 per cent calcium chloride solution was investigated by placing the briquettes in running water and determining their tensile strength after 3, 7 and 28 days. These experiments were also designed to find out whether some time is required for the completion of the reaction between calcium chloride and sodium silicate. The briquettes were sprayed with 15 per cent calcium chloride solution and tested after different intervals. The results presented in Table 2 show that the initial strength of the briquettes in the wet condition increases after 24 hr and the strength of the briquettes subjected to the action of running water was the same in all cases. Therefore, for satisfactory results, the briquettes, after treatment with calcium chloride, should be left to cure for 24 hr.

Experiments were also carried out to determine the optimum conditions for the reaction between calcium chloride and sodium silicate. It was found that complete drying of sand before the application of calcium chloride is not essential and what is actually required is the free flow of calcium chloride. Therefore,

TABLE 2 — STRENGTH OF Na_2SiO_3 AND $CaCl_2$ TREATED BRIQUETTES

(*Tensile strength of dry briquette before* $CaCl_2$ *treatment,* 256 *lb./sq. in.*)

IMPREGNATED BRIQUETTES TESTED AFTER	TENSILE STRENGTH (*lb./sq. in.*) OF BRIQUETTE							
	Fresh		After 3 days		After 7 days		After 28 days	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Immediately after preparation	89	166	122	151	120	147	123	144
8 hr	98	212	124	131	131	137	123	140
24 hr	137	210	123	132	133	139	142	146
72 hr	141	97	129	143	126	147	124	—

Briquettes were compacted with sodium silicate solution (22·5% strength), dried, impregnated with calcium chloride solution (strength, 15%) and left in the open for different intervals.

even partial drying of sand after impregnating it with sodium silicate serves the purpose.

Experiments carried out with sands of 0·73, 1·10 and 1·58 F.M. have indicated that with increase in the F.M. of sand the quantity of sodium silicate required for stabilization decreases. For stabilizing 100 sq. ft of 1 in. thick layer of sand of 0·73 F.M., 118·5 lb. of sodium silicate are required whereas for the same area made up of sand of 1·58 F.M., the quantity required is 66 lb.

The quantity of sodium silicate required for stabilizing 1 in. thick layer of sand (1·1 F.M.) over an area of 100 sq. ft is 75·5 lb. and the cost works out to Rs 7.00 (price of commercial sodium silicate, Rs 7.50 per 80 lb.). The quantity of calcium chloride required for treating the silicate-impregnated sand layer is 75·5 lb. of a 15 per cent solution of calcium chloride, the cost being Rs 6.00 [cost of commercial calcium chloride solution (*c.* 90 per cent) Rs 24.00 per cwt.]. The total cost thus works out to Rs 13.00.

The following procedure may, therefore, be adopted for stabilizing sand on the surface of embankments. The dry sand on the surface of the embankment, after proper dressing and compacting, is sprayed uniformly with sodium silicate solution (strength, 22·5 per cent) to soak the sand up to the desired depth. The treated sand surface is allowed to dry for more than two days and then sprayed uniformly with calcium chloride solution (strength, 15 per cent) to impregnate it completely.

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Water Dispersible DDT Formulations: An Analysis of the Problem

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An analysis of the relative merits of the various types of DDT (dichloro diphenyl trichloroethane) formulations used for insect control has been made on the basis of physico-chemical considerations. The desirable properties of a formulation have been discussed on the basis of the following factors: (1) suspensibility, (2) covering power, (3) lethal dose in minimum time, (4) residual toxicity, and (5) technological aspects. It is concluded that some type of paste formulation incorporating a non-volatile lipoid dissolving oil and containing thin needle-shaped DDT particles may prove to be the best.

FOR insect control, large quantities of DDT are used in India. An analysis of the relative merits of the various types of DDT formulations is, therefore, of importance as it will enable one to evolve or choose the most suitable formulation(s).

The commercial formulations in use can be classified into three types: (i) aqueous emulsions, prepared from a saturated solution of DDT in an organic solvent, or dilute solution itself; (ii) water dispersible formulations of DDT powder; and (iii) water dispersible pastes made with DDT and some oil. All these three types are dispersed in water to obtain suitable concentrations of DDT before spraying.

In this paper an analysis of the problem has been made on the basis of physico-chemical considerations indicating, in general terms, the desirable properties of a DDT formulation. The same considerations, more or less, will be applicable to similar insecticides such as Dieldrin. Even for formulating insecticides with fumigant action, such as Gammexane and Aldrin, these points may be worth keeping in view.

Definition of the problem

(1) The product should form stable suspension in water.

(2) Since DDT is a contact poison, the sprayed material should have high covering power and be readily available on the surface to come in contact with insects.

(3) For biological action, the lethal dose of DDT should be delivered as effectively and as quickly as possible. It is all the more desirable if DDT particles are picked up by, and also adhere to, the insects.

(4) The residual toxicity should be high, i.e. the product should remain in active condition on the sprayed surface for as long as possible.

(5) The product should be cheap and easy to store, transport and handle.

Analysis

Suspension stability

Suspensibility — The formulated emulsions or suspensions are usually taken in spray-gun reservoirs and sprayed with pumps. In order that the maximum amount of the DDT, if not all, should be sprayed out in the field, the stability of the emulsions or suspensions should be as high as possible. Otherwise, the sedimented product remaining in the can will be a waste. In fact, for water dispersible insecticide suspensions, the World Health Organization (WHO) specification[1] requires a suspensibility of 60 per cent or more in water (I.S. specification[2] requires 50 per cent suspensibility).

Suspensibilities of DDT particles in water dispersible formulations are closely related to the particle size. In the particular case of suspensions of the wettable powders containing spherical particles, it can be calculated from Stokes' law that, to satisfy the WHO specification, the particles should be lower than about 15 μ in diameter. However, depending on the efficiency of wetting and suspending agents incorporated in a formulation, the maximum permissible size could be correspondingly increased.

Choice of wetting agent — To prevent agglomeration and to effect the formation of a stable dispersion, the choice of a suitable wetting agent for incorporation in a formulation is very important. A wetting agent molecule, a portion of which attaches itself to the particle to be suspended and another portion anchors itself into the surrounding water medium, will increase the viscous drag on the particle during its sedimentation, thereby improving the suspensibility of the particle. One or more of the surface active agents from the following three types available commercially have to be used for this purpose: (a) anionic, (b) cationic, and (c) non-ionic. The details of their various properties and hence desirability related to the present problem are dealt with in a separate communication, but it can be stated here that the non-ionics present fewer problems of incompatibility and are most desirable because of their better emulsion-forming properties even in hard water.

Covering power

The efficacy of a formulation will obviously and considerably depend upon its covering power; therefore, the surface area actually covered by a certain quantity of DDT should be as high as possible. The control of particle size and shape is, therefore, quite important in this connection.

Particle size — The smaller the particle size the greater is the relative surface area and hence the covering power. Mathematical analysis in the case of spherical particles shows that the surface area covered by a certain quantity of DDT varies inversely with the particle diameter in the formulation. For example, a certain mass consisting of 1 μ diameter particles has a tenfold and hundredfold covering power over equal masses consisting of 10 μ and 100 μ particles respectively. From this point of view the emulsions do offer an advantage, provided the concentration of DDT in the initial solution as well as the droplet size of the emulsified DDT solution is controlled so that the particles of desired size will be formed after the evaporation of the solvent. Emulsions used in practice produce particles ($\sim$1 μ) whose size is expected to be much smaller than that obtained in water dispersible suspensions. However, if such products are sprayed on rough surfaces such as of mud, brick or concrete, considerable part of the DDT is likely to crystallize out within the pores or crevices. Further, when the sizes of such pores are smaller than the size of the portion of the insect body coming in contact with the surface, the insect-DDT contact can take place at the surface peaks only and hence most of the DDT will be unavailable to the insect. The DDT particles are thus used up in filling the pores and crevices only. In order to remove surface roughness and to seal up the pores, it is sometimes suggested[3] to cover the surface with a plastic or resinous film. However, such a procedure may be impracticable, particularly in rural conditions in India.

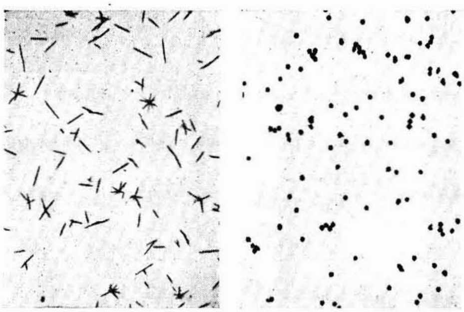

FIG. 1 — NEEDLE-SHAPED AND SPHERICAL PARTICLES OF DDT OF APPROXIMATELY EQUAL MASSES

As regards suspensions, the WHO specification[1] requires the DDT particles to pass through a 200 mesh sieve, i.e. the particle size should be less than about 70 μ, which is, therefore, the maximum limit. A size of 1 μ, on the other hand, may be considered as the minimum, usually met within the formulations. However, the optimum particle size range in a formulation to be used, according to the above discussion, should lie with a narrow distribution somewhere in the middle of this region so that the higher surface area is not offset by too small a particle size compared to the surface roughness of bricks and concrete.

Particle shape — Another notable consideration in addition to the size in this connection is the shape of the DDT particles. If one dimension of these spherical particles is increased to, say, about 10-25 μ —thus considering, e.g. cylindrical or needle-shaped particles of length 10-25 μ and diameter of 1 μ — the covering power is reduced by only 15 per cent of that of the 1 μ diameter spherical particles, but still is more than eight times that of the 10 μ diameter particles. For particles of the same mass, it is thus clear from the above and from Fig. 1 that the acicular particles are to be preferred to the spherical particles, taking into consideration together the covering power as well as the availability on the surface. Such needle-shaped particles thus combine the advantage of high covering power with that of availability to the insect. Such particles can be obtained, e.g. by controlled crystallization[4]. On the other hand, micronization of DDT is usually carried out by grinding which tends to give particles more towards the (less desirable) spherical shape due to the fact that when an acicular crystal breaks, the break will usually be transverse rather than longitudinal.

Lethal dose in minimum possible time

When an insect comes in contact with a DDT particle, it could be assumed that the DDT has to enter into the body of the insect through diffusion on a molecular scale. Therefore, the first requirement is that there should be intimate contact between the two over as large an area as possible. Secondly, the passage of DDT into the insect body should be as quick as possible, and thirdly, the time of contact should be increased as much as possible.

The insect body is covered with a lipoid layer which may be assumed to be in the solid or semi-solid state so that virtually there is a solid/solid interface between the DDT (if unmodified) and the insect. The rate of transport of matter by diffusion across a solid/solid interface is the lowest of all types and is much lower than a solid/liquid interface. The diffusion rate increases in the order solid/solid$<$solid/liquid$<$liquid/liquid$<$liquid/gas. Further, such a transport process is much influenced by the wettability and the rate of dissolution of one phase into the other.

In view of the fact that the insect surface cannot be modified, the DDT particles may be covered with a layer of non-volatile and lipoid dissolving oil which will also dissolve DDT to some extent. The process of transport of DDT will then be accelerated due to the existence of an interface intermediate between solid/liquid and liquid/liquid.

The lethal dose of insecticide is acquired by the insect, it is generally believed, by the insecticide particles being picked up by the insect and carried by it for sometime so that it goes on continually getting a dose of DDT for a long time. If this presumption is correct (and obviously it appears desirable to incorporate this condition), this brings in at least two important considerations: (a) the DDT particles should be small enough so that they could be easily carried by the insects coming in contact and (b) the DDT surface must have sufficient adhesion properties to stick easily to the body of the insect. Some aspects of (a) have been discussed earlier and to have properties required by (b), any lipoid wettable liquid surface over DDT, as would be obtained by covering it with a thin layer of oil, will introduce the required adhesion properties to a much greater extent than would be the case with a dry DDT surface.

Recently Dr T. S. Subramanian reported (private communication) that the toxicity of a surface sprayed with DDT, which was falling down with time, was found to rise again when some solvent was sprayed on the surface. Furthermore, the sprayed DDT in the supersaturated liquid state is more potent than the same in the crystallized state. This observation can be explained in terms of the nature of the DDT-insect interface. The dry surface of DDT is made wet by the spraying of fresh solvent and later it becomes saturated with DDT, thereby increasing the possibility of better contact and adhesion. Consequently the migration of DDT becomes easier and thus toxicity rises. It is again possible, under certain conditions, that some of the DDT particles previously lying in the pores and crevices are brought up to the surface as a result of solvent spray, thus replenishing the particles at the top which have much greater chance of getting displaced by the insects or due to other extraneous causes.

Residual toxicity

It has been reported that when DDT is sprayed on different types of surfaces such as glass, wood and mud blocks, and the toxicity tested in the usual way over periods of several weeks, the residual toxicity falls in the course of a few weeks, and this fall is most rapid in the case of mud surfaces. These results have been variously attributed to decomposition[5] of DDT in contact with clays or to sorption of DDT by clays. The inactivation of DDT by accelerated chemical decomposition in contact with the mud surface to any appreciable extent is now generally ruled out[3] as no decomposition products are detected. However, it may be of interest to examine if such inactivation is brought out due to, say, an isomeric change in the configuration of the molecule by adsorption.

Sorption — The non-availability of DDT is now generally attributed to its sorption by clay with the DDT gradually migrating into the clay matrix or pores. Further, the results of sorption of water and carbon tetrachloride are sometimes correlated and taken as positive index of sorption of DDT by clays[6]. Such results are not comparable since DDT is a much bigger molecule than either water or carbon tetrachloride, and may, therefore, experience stereochemical hindrance for accommodating in the layer lattice space of the expanding type of clays such as montmorillonite. Even in the absence of such hindrance, whereas water and carbon tetrachloride can easily migrate via the vapour phase, it will be an extremely slow process for DDT in the solid state because of its low vapour pressure at room temperature ($\sim 10^{-6}$ mm. of Hg). It should also be pointed out that such a phenomenon cannot arise in the case of non-expanding clays, e.g. kaolinite. On the other hand, adsorption on the outer surface of both types of clay particles, under certain conditions such as from solution or liquid phase, cannot be ruled out. As a result, DDT in mono- or multi-molecular layers will be rather strongly anchored on the surface of adsorbents and cannot, therefore, be easily dislodged and picked by the insects.

Recently, Headway and Barlow[7] have reported some striking results on sorption of insecticides such as DDT, Dieldrin and Gammexane in blocks made of some lateritic soils. All the insecticide particles disappeared from the sprayed surface and concentrated in the inner surface layers of mud after initial sorption and thereafter diffused further inside into the blocks with time[3]. They ascribed the results to a surface migration effect starting from the solid DDT particles. It should be stated, however, that this is a rather unusual phenomenon and needs extensive and critical experimentation from several angles to understand the mechanism of the process.

In view of the belief in the above sorption process, resins are incorporated[8] in some commercial products. This would appear as a negative approach in the light of our discussion, since any resin film on the DDT particle would create an additional barrier against the migration of DDT molecules into the body of the insect.

It is relevant here to point out that powder formulations incorporate rather larger quantities ($\sim$20-40 per cent) of clay type material to aid in grinding and to improve the keeping qualities of the product. But by this way, the formulation itself has incorporated in it large quantities of active adsorbing material which will make part of the DDT unavailable for the insects. Furthermore, in view of their suspending action, some clay particles may cluster around the DDT particles and thus virtually cover up part of the effective DDT surface. A proper choice of the filler (clay) material is, therefore, important.

Role of the nature of the sprayed surface — It may further be noted that while comparing toxicity results obtained by spraying DDT on glass, polished wood and mud surfaces, one should critically examine the following factors: (i) in order to obtain comparable toxicity results, it is required that the amount of DDT sprayed per unit area should be the same in each case. But this requirement will be very difficult to be fulfilled in practice since the geometrical area is not a true measure of the actual surface area and the latter will be much larger in the case of rough surfaces. Hence, although the same amount of DDT is sprayed over the different surfaces of the same geometrical area, the dosage (mg./sq. ft) may differ enormously; (ii) the rate of drying of DDT particles sprayed on different surfaces would differ considerably[7] and correspondingly affect the residual toxicity results; and (iii) the extent of adhesion and the relative adhesion strength of DDT to various surfaces may differ appreciably. This will affect the toxicity results. It is possible that with time DDT particles will be more strongly adhering to mud and brick type of surfaces by some type of sintering action due to solid-solid contact under the prevailing conditions as the sintering temperature (softening point of technical DDT is about 85-95°C.) of DDT is quite low. If insecticidal efficiency is dependent to some extent on the probability of an insect carrying the DDT particles with it after contact, the toxicity of the surface will, therefore, fall. However, it can be appreciated that if there is an intervening liquid layer between DDT and mud surface preventing direct contact, such strong adhesion by fusion will not occur. Of course, the surrounding liquid layer will increase adhesion of the DDT initially but in the long run this will not affect as adversely as it would occur in the former case.

Technological aspects

One has to examine relative formulation cost, transport, storage, shelf-life and handling problems of the final product.

Solutions and emulsions — Since the formulated product in this case is in the liquid state, difficulties and loss by leakage during transport and storage come up as metal containers have to be used. The solvents such as kerosene and aromex, which are generally used, are expensive in India. Further, emulsions of DDT in an organic solvent in water do not ordinarily have sufficiently long shelf-life. On the other hand, it is, no doubt, easy to handle such formulations.

Wettable dry powders — The usual process of preparation of wettable powders is by grinding a mixture of DDT, clay and wetting agent in a jet mill, the particles of desired fineness being collected through cyclone separators. It is a rather long and inefficient process and moreover requires expensive equipment. However, it should be mentioned that the product is easy to carry and handle but presents storage (without causing deterioration of the powder) difficulties in tropical countries such as India.

Oil-bound pastes — Formulations in paste form consist of DDT, a non-volatile oil and a wetting agent. These can be easily prepared and also present fewer difficulties than solutions and emulsions for storage and transport. If such pastes contain more than 60 per cent technical DDT, the expenses incurred in transporting them would not be more than those incurred in carrying filler materials employed in dry wettable powders since the percentage of technical DDT in the latter is also of the same order or less. Our experience shows that pastes can be made to form very stable suspensions, and need simple equipment for their preparation. However, they still demand more effort and care to prepare the final suspensions for spraying in the field.

Conclusion

In the light of the above discussions it is tentatively concluded that some type of paste formulation incorporating a non-volatile lipoid dissolving oil and containing needle-shaped DDT particles may prove to be the best. Reports on the actual attempts that have been made in the National Chemical Laboratory to incorporate many of the desirable properties in several DDT formulations will be communicated separately.

Acknowledgement

The authors wish to record their thanks to Dr D. K. Vishwanathan, ex-Director, and Dr T. Ramachandra Rao, Assistant Director (Malariology), Department of Public Health, Bombay State, for valuable discussions on this problem, to the Indian Council of Medical Research for sponsoring a project in this laboratory and to Dr H. L. Bami of the Malaria Institute of India for helpful criticism.

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REVIEWS

CONTRIBUTIONS IN GEOPHYSICS—International Series of Monographs on Earth Sciences, Vol. I. Edited by H. Benioff, M. Ewing, B. F. Howell & F. Press (Pergamon Press Ltd, London & New York), 1958. Pp. viii + 244. Price 60*s*. net

This is a volume containing an outstanding collection of seventeen papers contributed by leading geophysicists of several countries. The publication has been brought out in honour of Prof. Beno Gutenberg on the eve of his retirement as Director of the Seismological Laboratory of the California Institute of Technology. The papers cover a wide range of topics on seismological studies and researches devoted to gain some knowledge about the earth's interior. The results of some of the latest investigations carried out by the respective contributors are set out in these papers. Collectively, they reflect the current state of our knowledge on some of the problems of earthquakes and the earth's interior. Perhaps in no branch of scientific study is international co-ordination, collaboration and co-operation so essential as in the seismological subjects which have to depend on data obtained over large parts of the globe, transcending geographical and political boundaries. In that sense, the volume under review is indeed an international tribute to Prof. Gutenberg.

Markus Bath, in his paper on " The energies of seismic body waves and surface waves ", has furnished the results of the energy computations for a number of shallow focus earthquakes. He points out that the extinction (scattering) is very strong for the body waves and that the large extinction of the high frequencies in the focal region constitutes the most serious difficulty in energy determinations from body waves.

Perry Byerly and John DeNoyer, in their contribution entitled " Energy in earthquakes as computed from geodetic observations ", have estimated the depth of fault breaks and the energy released from three earthquakes — the San Francisco (California) earthquake of 1906, the Imperial Valley (California) earthquake of 1940, and the Dixie Valley (Nevada) earthquake of 1954.

Robert Stoneley's contribution on " The variation of amplitude and energy with depth in Love waves " is mainly devoted to the investigation on the variation of amplitude of Love waves propagating in a solid having two uniform surface layers, of equal thickness underlain by a very great depth of uniform material. The relative amplitudes of the vibrations have been computed for eight different depths in respect of thirteen different values of the wave velocity, covering the whole permissible range of wave velocities.

Pietro Caloi, in his interesting article " Some phenomena preceding and following seismic movements in high seismic zones ", has drawn attention to the strict relation between seismic phenomena and slow angular changes of the apparent vertical. According to him, wide Alpine zones are periodically affected by tiltstorms lasting several days and also that seismic activity begins with the accentuation of the slow ground tilt, shown by tiltmeters.

Wilhelm Hiller's article " Zur Mechanik und Dynamik der Erdbeben " (On the mechanics and dynamics of earthquakes) suggests that the earthquakes are connected with conditions in the much deeper parts of the earth than has usually been assumed. According to him the existence of somewhat slow fluidal movements or currents deep in the earth's core (which has been so far generally considered as stable in a condition of equilibrium) would now be acceded.

John H. Hodgson's investigation regarding " Direction of displacement in western Pacific earthquakes " and Chuji Tsuboi's contribution " On the seismic activities in and near Japan " offer very instructive analytical deductions of the data from a large number of earthquakes.

The present state of evidence on the solidity of the earth's inner core has been very ably summarized by K. E. Bullen. According to him, all the available evidence supports the solidity of the inner core in the sense that the inner core is capable of transmitting S. waves, should these be excited in it. J. Lehmann's paper entitled " On phases in earthquake records at epicentral distances of 105° to 115° " points out that phase variations are not marked by identical waves everywhere. The constitution and depth of the earth's surface layers vary and the constitution of the upper mantle is not everywhere the same.

J. P. Rothe's " Quelques experiences sur la structure de la croûte terrestre en Europe occidentale " (Some experimental studies on the structure of the earth in Western Europe) deals with the results obtained in Germany and France by artificial explosions. Rothe concludes that the depth to Mohorovicic discontinuity is 28 km. Closely related to the above subject is the contribution by Howard E. Tatel and Merle A. Tuve on " Seismic observations at one kilometer depth". The experimental studies were made of the earth motion at 3000 ft depths in gas wells in Pennsylvania State. The observations denoted that the ground motion is considerably less than the surface motion, which indicates that the surface waves are surface bound either as Rayleigh waves or upwardly refracted secondary P-waves. The lesser ground motion in the interior holds promise for better signal to background ratio for observation of distant shots.

Francis Birch's "Interpretation of the seismic structure of the crust in the light of experimental studies of wave velocities in rocks" suggests that the data show the seismic velocities fall in most cases between the values for average granite and average gabbro. Gradual increase of velocity with depth can be interpreted in terms of increasing gabbroic component. However, Birch points out that in view of the fact that the same velocities are exhibited by other rocks, especially metamorphic rocks of different composition, the solutions in terms of granite and gabbro are not unique.

C. L. Pekeries and H. Jaroseh have presented their results of a systematic study of the "Free oscillation of the earth". They are inclined to suggest provisionally, that the existence of the liquid core, as well as the effects of the constraints imposed by the boundary conditions at the surface where the rigidity is smaller than the average, tend to make the real earth behave dynamically in spheroidal vibrations as a less rigid body than is represented by the mass average value of its rigidity.

The last five contributions in this volume, though not exactly on seismological aspects, are, nevertheless, connected with problems of geophysics in which Prof. Gutenberg is himself so much interested.

"The Geophysical history of a geosyncline" by F. A. Vening Meinesz throws some new light on the nature of the uniaxial horizontal compression in the earth's crust. W. A. Heiskanen and U. A. Uotila have presented a paper on "Some recent studies on gravity formulas". H. E. Landsberg has dealt with "Data processing in geophysics". He has described the new system of machine and electronic computation and processing of geophysical data. Lastly, Walter Elsasser and Walter Munk, in their article entitled "Geomagnetic drift and the rotation of the earth", point out that the displacement of the pole of rotation due to motion in the core is negligible.

Each of the foregoing seventeen articles has well arranged illustrations, graphs and tables, and clearly set out equations with conventional notations, and a list of references. A general index appearing at the end of this volume is very useful. The printing and get-up of the book are superb.

This form of honouring a great scientist is thrice blest — firstly, him who is honoured; secondly, those who joyfully contribute the articles and thus pay their tribute; and thirdly, in a larger measure, the general readers and research workers who get such authentic and up-to-date information in one handy volume.

M. B. R. Rao

CELLULOSICS — Reinhold Plastics Applications Series by Walter D. Paist (Reinhold Publishing Corporation, New York), 1958. Pp. xi + 270. Price $ 5.75

The Reinhold Publishing Corporation have started a useful series of publications on the application of plastics for various purposes. Four volumes on polyurethanes, polyamides, etc., have already been published and the present one by Walter Paist is the fifth in the series.

Cellulose, as an industrial raw material for various chemical derivatives, fibres and plastics, has gained considerable importance during the last three decades. After cellulose nitrate came the regenerated fibres, and cellulose esters and ethers have followed them, and recently the 'oxidized' celluloses have been engaging the attention of research workers. Much of the development work on the chemical derivatives of cellulose depends on their correct and efficient application. In that sense a considerable amount of development work appears to be very necessary if the potentialities of cellulose as a raw material were to be fully realized. The present book on 'Cellulosics' is, therefore, a welcome addition to the literature on the subject.

The first chapter describes the various members of the cellulosic family and the second deals with their chemistry in an elementary manner. The third, devoted to the properties of cellulosics, is a useful one and provides data on solubility, physical properties of fibres and moulded articles. Mention is also made of the protective coating field. Detailed information regarding each member of the family is also included. The fourth chapter deals with methods of fabrication of the various cellulosics. Very useful information is given regarding fabrication of fibres, films, sheets, laminates, extruded articles, protective coatings and adhesives. In the fifth chapter on the application of extruded and cast cellulosics, it is pointed out that the biggest field lies in the packaging industry. Interesting details are given regarding bags, boxes, tubes and bands, overwraps, laminates, photographic and reproduction materials, tapes for typewriters, sound and TV, and various other applications. The sixth chapter is devoted to injection moulded cellulosics and includes interesting details regarding auto-parts, telephones, electrical and home appliances, toys, etc. The seventh chapter deals with protective coating and lacquers and includes their applications in diverse fields such as peel coatings, lacquers for automotive and aircraft, fabrics, cables, leather, hair and nail, wood, various plastic sheets and film. Some useful hints are also included on textile warp sizing. The eighth chapter deals with adhesives and binders and covers diverse fields such as paper, pencils, ceramics, pharmaceuticals, agriculture, textiles, explosives, etc. The ninth chapter is concerned with interesting miscellaneous applications, the tenth chapter with fibres and fabrics, and the last with new derivatives and future trends.

On reading the book, one is impressed with the range of subjects covered and the vast amount of data collected. But, by its very nature, diversity always entails a certain loss in thoroughness and the present treatise is no exception. The book would have been more useful if the author had included important literature references. Despite these minor drawbacks the book deserves a place in the shelf of every student and manufacturer connected directly or indirectly with cellulose-based industries.

V. B. CHIPALKATTI

LUBRICATION SCIENCE AND TECHNOLOGY: Vol. I, No. 1. Edited by John Boyd (Pergamon Press Ltd, London & New York), 1958. Pp. vii + 231. Price £ 5 5s. net

The American Society of Lubrication Engineers have now brought forth a publication under the caption *Lubrication Science and Technology*, which is the *Transactions of the Society*. This will be a semi-annual publication.

The Society is to be congratulated in trying to bring together under one cover various researches and development work in the field of lubrication. The publication will be a useful and ready reference to those engaged in research in this field.

The collected publications in this particular number under review cover a vast field of research and development that has been undertaken by various organizations. They are of great interest to both the research worker and the designer. A number of articles included depict the latest techniques adopted in the study of various lubrication problems.

A. V. SREENATH

NOMOGRAMS FOR CHEMICAL ENGINEERS by O. P. Kharbanda (Heywood & Co. Ltd, London), 1958. Pp. xii + 247 (103 illustrations). Price 80s. net

For the development of laboratory study and pilot plant work to the stage of a commercial plant design, the chemical engineer needs voluminous data. These should be available as a concise practical summary for which nomography is a useful technique. The collection of nomographs brought out by Dr O. P. Kharbanda is a welcome addition to the existing facilities available to the chemical engineers and, in particular, to those who are engaged in design work.

The volume under review has a collection of one hundred and two nomograms, including eight originally published by Dr Kharbanda covering the following topics; Physical properties, 58; Absorption, 1; Distillation, 11; Fluid flow, 17; Fluidization, 3; Heat transfer, 4; Humidification, 1; Combustion, 2; and Vessel design, 5.

Only nomograms of general applicability have been selected excluding those confining to one property of one compound or if the relevant equation is of limited use. The equation forming the basis is given in every case. Instructions for use and solved examples show how the charts are to be used. Full references to the original publications from which the nomograms are taken and additional references have been given as a guide to the literature.

The size (20 × 25 cm.) chosen for the plates makes it very convenient for accurate interpolation. The printing is very clear, eliminating eye strain while reading off values from the charts. The subject index is provided in three languages — English, French and German. The special backed binding allows the pages to be laid flat for convenient use. In addition to the page numbering it would have been better if the nomograms were also given serial numbers and the title of each had been printed on the plate.

B. NARAYAN DAS

THERMODYNAMICS by V. M. Faires (Macmillan & Co. Ltd, New York), Third Revised Edition, 1957. Pp. xxi + 543. Price $ 7.50

In the book under review, the author's aim is to present an undergraduate text-book for students of engineering and is specially written for home-study. The level of mathematics and physics required is well within the powers of Indian students who have satisfactorily completed their Intermediate and/or Pre-Engineering course. The treatment is fairly rigorous and the author, being an experienced teacher, has spared no pains to smoothen the students' path by patient and elaborate explanation, emphasizing the more useful relationships and employing to the fullest extent the art of repetition without tiring the reader. Even the important figures have been repeated to go conveniently together with the relevant text.

The student is introduced early to the concept of entropy and the use of temperature-entropy coordinates. Entropy is discussed in greater detail later, when the study of the second law is taken up. After covering a good part of the theory in the first part of the book the author has included a considerable amount of matter on the practice and performance of heat engines. There is also a useful chapter on Combustion and Products of Combustion. The last three chapters deal with Refrigeration, Air-conditioning and Heat Transfer Fundamentals.

One cannot deny that the ideas of a subject like thermodynamics can be best assimilated by working out a number of problems, and this is what is lacking in the book under review. With the general rise in prices of technical books, it would hardly be reasonable to expect our students to invest further on a separate book of problems. However, it must be said that the book has a fair number of worked out problems. A notable feature that merits special mention is the incorporation of interesting biographical footnotes.

M. V. C. SASTRI

PRECIPITATION EFFECTIVENESS IN RELATION TO THE VEGETATION OF INDIA, PAKISTAN AND BURMA — University of Bombay Botanical Memoirs, No. 3, by F. R. Bharucha & G. Y. Shanbhag (University of Bombay, Bombay), 1957. Pp. 109. Price Rs 1.50

The classification of the climates of the world on a rational basis still continues to challenge the ingenuity of elder climatologists and seasoned botanists all over the world. Prof. F. R. Bharucha (botanist) and Prof. G. Y. Shanbhag (physicist) have tried their hands at this complex problem, so far as the Indian sub-continent is concerned, in the memoir under review.

While the climatologist can delve into the past records of climate now available for many decades, over the more civilized and technically advanced regions of the world, the botanist suffers from the difficulty that Man's activities through the ages have resulted in large parts of the earth becoming covered with cultivated food crops and orchards. Thus, while gaps in the climatological pattern over the earth are being rapidly bridged of late, there is no hope of reconstructing the original distribution of natural vegetation before the interference by human beings. Thus, attempts to evolve a true climate-vegetation pattern are beset with difficulties. What is true for the earth as a whole, is equally true for the Indian sub-continent.

In their enthusiasm for systematic classification of the 'climate-vegetation complex', scholars usually present an idealized pattern to explain some of the very broad features. In this task they have perforce to depend more on the available picture of the distribution of climate than on any precise knowledge of the distribution of the naturally occurring vegetation, except in the uninhabited or very sparsely populated and/or semi-arid zones that still largely retain their scanty original or natural or wild vegetation.

While pioneers like Koppen have been cautious enough to confine themselves to the broad world features, the present authors have made bold to attempt a very detailed classification of the 'plant-climatic' complex in a relatively small area like the Indian sub-continent which is not only limited within the tropical and lower temperate zones but also sheltered by the enormous Himalayan barrier which practically shuts off all influences from the trans-Himalayan temperate and frigid zones.

In this memoir the authors have set for themselves the task of applying Koppen's and Thornthwaite's classifications to the vegetation of India and Burma. They find that neither of these classifications fits in with the vegetation map of India as prepared by Champion in 1920, but the distribution of the precipitation-evaporation ratio (P/E) over India as calculated by them fits in nicely with the vegetation pattern over the country.

It is necessary to examine why the authors' P/E pattern does appear to explain Champion's map. The ratio P/E becomes large when P increases or E decreases. It is well known that in areas or seasons of heavy precipitation the evaporating power of the air near the ground also decreases. So that, in a general way, the distribution of P may be expected to be consistent with that of P/E. Again, in preparing maps showing the areas that may be classified as 'tropical wet evergreen', 'tropical dry deciduous', 'tropical dry evergreen', 'sub-tropical wet' and so on, scholars decide the boundaries of these regions consciously or unconsciously on the basis of the annual rainfall distribution over the country which is known more precisely than the distribution of the vegetative types; so, to the extent Champion's map is already influenced by the rainfall distribution over India it would indeed be surprising if the pattern of P/E and the above-mentioned map did not fit in with each other! The authors have not troubled themselves to examine this possibility.

In the last chapter, the authors find that P/E is correlated with *n*, the number of rainy days during which precipitation P falls. This is hardly surprising for, it is obvious that both P and *n* and P/E should be correlated with each other.

One cannot conclude this review without referring to a rather unusual feature of this publication. The authors have practically adopted or transferred into their memoir, without proper acknowledgement by appropriate quotation marks, considerable material from several earlier writers on the subject. To mention only two out of a large list, in Chapters III and IV, several pages of (i) Thornthwaite's paper on " An approach toward a rational classification of climate " [*Geographical Rev.*, **38** (1948)] and (ii) Raman and Satakopan's paper on " Evaporation in India calculated from other meteorological factors " [*Indian met. Dept.*, *Scientific Notes*, **7** (1934), 61] respectively, have been copied without acknowledgement. In all these instances the authors repeat the entire matter with feeble attempts at minor alterations in the text by occasionally changing a sentence from the passive into the active, deleting a ' but ', etc. Instead of swelling their text by such a questionable technique, they should have presented the substance of Thornthwaite's, Raman and Satakopan's and other writers' arguments and ideas in their (authors') own words and, wherever this was impossible, to show the quoted portions within inverted commas.

The memoir may impress the uninitiated lay reader, but would fail to satisfy the critical demands of a professional worker.

L.A.R.

SURVEYS OF INDIAN INDUSTRIES by B. S. Rao (Oxford University Press, Bombay). Vol. 1, 1957. Pp. vi + 358. Price Rs 15.00. Vol. 2, 1958. Pp. 320. Price Rs 20.00

The author of these surveys is the industrial correspondent of the *Statesman*, Calcutta, and his writings are marked for their objectivity and comprehensiveness. These lucid surveys, which appeared earlier as individual articles in the *Statesman*, depict the present state and structure of Indian industries. The author states that the subject matter of the articles has been revised and brought up to date as the rapidly changing conditions permit, and in the prefatory note he observes, " I lay no claim to completeness but rather I have endeavoured to cover the vast and ever-widening field by process of selection, elimination and condensation ".

The twelve chapters comprising the first volume deal with (i) iron and steel, (ii) non-ferrous metals, (iii) automobile, (iv) diesel engines, (v) light mechanical engineering, (vi) light electrical engineering, (vii) coal, (viii) electricity generation and supply, (ix) petroleum, (x) chemicals and (xi) fertilizers. The second volume surveys cotton textiles, jute, tea, sugar, fruit and vegetable preservation, paper, cement, ceramics, glass, shipbuilding, shipping and the film industries.

Techno-economical surveys such as the ones presented involve tremendous amount of labour to make them accurate and up to date. Often, however, the painstaking labour is not adequately rewarded as the official figures made available for reproduction are frequently back-dated. For instance, the *latest* figures quoted in most cases in the first volume are for the year 1954 and in the second volume they are for 1955, that is the figures relate to those even before the end of our First Five-Year Plan! The targets and production have vastly changed since then in practically every field and probably one has to be content with the thought that in a book of this nature only a ' relative contemporaneousness is possible '. Yet these reviews serve a useful purpose as a ' chronicler ' and even to a certain measure to help gauge the rate of progress of the dynamic economy of a country.

The printing and general production aspects of the volumes are of a high standard. A novel and useful feature of the publications is the indexing system followed: the main subject heads (such as names of industries) are classified on the basis of individual economic aspects such as imports, cost of production, tariff, research, etc. Occasionally certain lapses like the omission of units in tabulated data (as in p. 117, Vol. 2) are noted. Titles to the individual tables may add to their value. In the opinion of the reviewer, in a historic perspective it is difficult to appreciate the significance of quotations and opinions of people in authority. These, though pertinent at the time these surveys appeared in the *Statesman*, probably lose much of their value in a book which is expected to mainly serve as reference to economists and planners.

The price at Rs 15 and 20 of the two volumes respectively is a bit on the high side for individual buyers. Yet the volumes carry important articles of topical interest and are decidedly welcome reference works to every student of economics in the country. To enhance the utility of the volumes, the data presented could be periodically revised and issued as supplements.

S. RANGA RAJA RAO

TALANTA — An International Journal of Analytical Chemistry (Pergamon Press Ltd, New York & London), Vol. 1, Nos. 1 & 2, July 1958. Annual subscription: $ 17.00 or £ 6

In a foreword to the first issue of *Talanta*, Prof. Feigl, internationally known for his contribution on ' spot-testing ', remarks, " The present high standard of chemical and physical analysis could never have been achieved without research which in respect of originality, intensity and utility, ranks as high as any research work carried out in other fields of chemistry ". The importance of chemical analysis was never so fully recognized before as today, particularly since the spectacular developments in nuclear and biological sciences and technology. This needs original research of high order and the present time, as never before, augurs well for the intensified research programme in analytical chemistry in the universities, research institutions and works with a consequent huge output meriting publication. In the past there has been a considerable lag between the completion of a research and its publication primarily due to an inadequate number of journals of sufficiently high professional status. It is hoped that this handicap will be overcome by the medium offered by this new journal which is being brought out by the Pergamon Press with the editorial collaboration of well-known investigators in the field of analytical chemistry from all over the world. The present issue contains both original articles and résumé of important development in selected fields of analytical chemistry. A particularly valuable article is by Prof. Beamish on " Critical evaluation of the gravimetric methods for the estimation of platinum metals " and another by Flaschka on " Complexometric titrations ". If the high standard set by the first issue is maintained, the editors and the publishers of *Talanta* are to be congratulated for providing in this new venture a medium of authoritative information and early publication of results of interest. This journal will not only occupy an important position in the library and the laboratory of the analytical chemist but also of other chemists who today must rely more and more on the approach to their problems via analytical chemistry.

M. R. VERMA

MANAGEMENT — PRINCIPLES AND PRACTICES by D. E. McFarland (The Macmillan Company, New York), 1958. Pp. x + 612. Price $ 6.95

The book is a welcome departure from the usual publications on management as it deals with the fundamental management principles and practices as well as its distinct field of activity. The book has been divided into four parts, viz. the field of management, principles and fundamentals of management, human relations and personnel management, and finally, operating management.

Management is a process that involves interrelationship of human problems and its practice is an absolute necessity for the survival of any business enterprise. The author has discussed the concepts of scientific management with reference to the work of the pioneers like F. W. Taylor, F. B. Gilbreth and others. Mention could have usefully been made about the work of Henry Fayol, whose contribution towards the evolution of scientific management is of considerable importance.

The major elements of managerial process, namely planning, organizing, control, co-ordination and motivation, have been explained in detail. Various obstacles to carrying out the process of management have been discussed. There is a useful chapter on the fundamental characteristics of managerial decision and the art of decision-making. In the chapter on human relations aspect in management, the author has made a critical appreciation of the essence of Howthorne experiments, carried out by Elton Mayo and others, to have a knowledge of the human behaviour in a particular work situation and its relation to productivity. The chapter on industrial engineering has been well designed to give the readers a balanced knowledge of the various functions involved, such as work study and other operational problems. It would have been useful if the author had included in this chapter the character and scope of operational research. At the end of the book, thirteen well-chosen management cases have been included, for the purpose of providing useful material for ' realistic training in problem solving technique ', considered essential to enhance the skill of decision-making.

The book will help the students and teachers of management science to understand the fundamental concepts of management and enlighten those who still believe that management is either an intuitive process or a mere assembly of systems and procedures.

S. K. BASU

ELECTRONIC SEMICONDUCTORS by E. Spenke. Tranlated by D. Jenny, H. Kroemer, E. G. Ramberg & A. H. Sommer of RCA Laboratories, Princeton, New Jersey (McGraw-Hill Book Co. Inc., New York), 1958. Pp. xxvi + 402. Price $ 11.00

This is a translation of the second German edition of Eberhard Spenke's book *Elektronische Halbeiter* by Jenny, Kroemer, Ramberg and Sommer of the RCA Laboratories who are themselves active research workers in the semiconductor field. As is to be expected, the translation is excellent and the book reads easily and cogently which cannot be said of many translations. Inclusion of problems at the end of each chapter and modifications of nomenclature and symbols as well as the inclusion of a whole section on junction capacitance have enhanced the usefulness and completeness of the book.

The subject of semiconductors is a rapidly growing one and with new developments in the offing a book on the subject will have to be really good if it is to excite the interest of those who are keen on understanding semiconductors.

Schottky, in his foreword to the book, has indicated how the idea of the book originated. It is the outcome of a number of lectures on the fundamentals of semiconductor physics delivered by Spenke to ' physical meetings and groups of younger colleagues in industry '. The treatment of the subject follows the earlier classic on the subject by Shockley in that the first five chapters cater specifically to the application-minded readers while the second part deals with the fundamentals in greater detail.

Subjects covered in the first part are: (1) conduction mechanism in electronic semiconductors; (2) nature, models and reactions of impurities and imperfections; (3) ' the hole '; (4) mechanism of crystal rectifiers; and (5) physical mechanism of crystal amplifiers (transistors).

The first chapter discusses a semiconductor on the basis of the Band model and atomistic theory. The inherent limitations of the two methods of presentation are brought out clearly. The second chapter discusses valence and ionic crystals with substitutional impurities, vacancies and interstitials. Next the concept of ' the hole ' is discussed. The deficiency in the picture of holes concept when dealing with electron interaction is pointed out. The fourth and fifth chapters deal with physical aspects of metal semiconductor contact and the p and n junction leading on to the characteristics of transistors.

Part II deals in greater detail with the fundamental aspects of the first part and points out clearly many unsolved problems. The subjects covered are: (6) approximation methods in the quantum mechanics of the hydrogen molecule; (7) Band model; (8) Fermi statistics of the electrons in a crystal; (9) the dynamic approach to imperfection equilibria and the inertia of impurity reactions; and (10) boundary layers in semiconductors and metal conductor contacts.

Though these aspects have been dealt with elsewhere in literature and particularly by Shockley, the fact that this is a later publication has helped in presenting the same subject in a more precise form. The careful treatment of the Zener effect in Chapter VII, and the statistics and kinetics of electrons as modified by electrostatic potentials in Chapter VIII can be cited as examples. One cannot do better than to quote Schottky who in his foreword to the book says, " The thoroughness and realism of the author are a guarantee that, in this more advanced portion of the book the existing limits to our knowledge are never obscured and that, at the same time, within these limits meaningful considerations and conclusions are derived and proved in a reliable manner."

The general get-up of the book, clear illustrations, the meticulous classification and division into subsections whose titles are self-explanatory, and the more than useful detailed contents are a great help to the reader. Illustrations and mathematical equations are numbered to indicate not only the chapter but the sub-section. The title on top of each left-hand page gives the chapter number and heading and that on the right side gives the number and title of the sub-section. Such attention to minute details speaks of the thoroughness of the author and adds greatly to the pleasure of reading the book.

The German edition of the book was published by Springerverlag, Berlin, and the English translation by McGraw-Hill Book Co. Inc. in 1958. Dr Spenke is a co-worker of Prof. Walter Schottky, and coming as it does from such an eminent authority in the semiconductor field, the book naturally commends itself to all serious students of the subject.

T. V. RAMAMURTI

Publications Received

Transistor Technology: Vol. 3 — Bell Laboratories Series. Edited by F. J. Biondi (D. Van Nostrand Co. Inc., London, Toronto & New York), 1958. Pp. xiii + 416. Price 94*s*.

Soviet Pharmaceutical Research: Vol. I — Pharmaceutical Chemistry (English translation), (Consultants Bureau Inc., New York), 1958. Pp. 447. Price $ 95.00

Soviet Pharmaceutical Research: Vol. II — Pharmacognosy (English translation) (Consultants Bureau Inc., New York), 1958. Pp. 410. Price $ 90.00

Soviet Pharmaceutical Research: Vol. III — Medicinal Chemistry (English translation) (Consultants Bureau Inc., New York), 1958. Pp. 556. Price $ 100.00

Tables of Thermodynamic Functions of Air for the Temperature Range 6000°-12000°K. and Pressure Range 0·001-1000 Atm. by A. S. Predvoditelev, E. V. Stupochenko, E. V. Samuilov, I. P. Stakhanov, A. S. Pleshanov & I. B. Rozhdestvenskii (Infosearch Ltd, London; *Sole Distributors (except U.S.A.)*: Cleaver-Hume Press Ltd, London), 1958. Pp. 301. Price 63*s*.

Electrical Engineering Practice: Vol. I — A Practical Treatise for Electrical, Civil and Mechanical Engineers by J. W. Meares & R. E. Neale (Chapman & Hall Ltd, London; *Distributors in India*: Asia Publishing House, Bombay), Sixth Revised Edition, 1958. Pp. xiii + 716. Price 60*s*. net

Mathematical Theory of Compressible Fluid Flow — Applied Mathematics and Mechanics: Vol. III by Richard Von Mises, completed by Hilda Geiringer & G. S. S. Ludford (Academic Press Inc., New York; *Distributors in India*: Asia Publishing House, Bombay), 1958. Pp. xiii + 514. Price $ 15.00

Dynamical Analogies by Harry F. Olson (D. Van Nostrand Co. Inc., Princeton, Toronto, New York & London), Second Edition, 1958. Pp. xi + 278. Price 51*s*.

Machine Design by R. C. Patel & A. D. Pandya (Acharya Book Depot, Baroda), Second Edition, 1958. Pp. xiv + 424. Price Rs 12.50

Principles of Electronics by H. Buckingham & E. M. Price (Cleaver-Hume Press Ltd, London), Second Edition, 1958. Pp. 419. Price 17*s*. 6*d*. net

Liquid Scintillation Counting — Proceedings of a Conference held at North-western University, August 20-22, 1957. Edited by Carlos G. Bell, Jr & F. Newton Hayes (Pergamon Press Ltd, London), 1958. Pp. xi + 292. Price 70*s*. net

Scientific Manpower in Europe by Edward McCrensky (Pergamon Press Ltd, London), 1958. Pp. ix + 188. Price 40*s*. net

Processed Plant Protein Foodstuffs. Edited by Aaron M. Altschul (Academic Press Inc., New York; *Distributors in India*: Asia Publishing House, Bombay), 1958. Pp. xv + 955. Price $ 26.00

Advances in Chemical Physics: Vol. I. Edited by I. Prigogine (Interscience Publishers Inc., New York), 1958. Pp. xi + 414. Price $ 11.50

Proceedings of the International Symposium on Transport Processes in Statistical Mechanics. Edited by I. Prigogine (Interscience Publishers Inc., New York), 1958. Pp. x + 436. Price $ 10.00

Phosphorus and Its Compounds: Vol. I — Chemistry by John R. Van Wazer (Interscience Publishers Inc., New York), 1958. Pp. xiii + 954. Price $ 27.50

The Theory and Design of Magnetic Amplifiers — Automation & Control Engineering Series by E. H. Frost-Smith (Chapman & Hall Ltd, London; *Distributors in India*: Asia Publishing House, Bombay), 1958. Pp. xix + 487. Price 75*s*. net

Cerenkov Radiation and Its Applications by J. V. Jelley (Pergamon Press Ltd, London), 1958. Pp. vii + 304. Price 65*s*. net

Reports on the Progress of Applied Chemistry — Vol. XLII: 1957. Edited by H. S. Rooke (Society of Chemical Industry, London), 1957. Pp. 910

Coated Abrasives — Modern Tool of Industry, Coated Abrasives Manufacturers' Institute (McGraw-Hill Book Co. Inc., New York, Toronto & London), First Edition, 1958. Pp. v + 426. Price $ 8.50

Refrigeration and Air Conditioning — McGraw-Hill Series in Mechanical Engineering by W. F. Stoecker (McGraw-Hill Book Co. Inc., New York, Toronto & London), 1958. Pp. vii + 397. Price $ 8.00

Successful Process Plant Practices — Operation, Maintenance and Safety by Robert L. Davidson (McGraw-Hill Book Co. Inc., New York, Toronto & London), 1958. Pp. xxii + 302. Price $ 10.00

Modelmaking for Industrial Design by Ralph R. Knoblaugh (McGraw-Hill Book Co. Inc., New York, Toronto & London), 1958. Pp. xi + 276. Price $ 9.75

Composite Construction in Steel and Concrete for Bridges and Buildings by Ivan M. Viest, R. S. Fountain & R. C. Singleton (McGraw-Hill Book Co. Inc., New York, Toronto & London), 1958. Pp. xv + 176

NOTES & NEWS

Symposium on cosmical gas dynamics

A RECENT ISSUE OF THE *Reviews of Modern Physics* [**30** (3) (1958)] is solely devoted to the proceedings of the Third Symposium on Cosmical Gas Dynamics, organized jointly by the International Union of Theoretical and Applied Mechanics and held at the Smithsonian Astrophysical Observatory, Cambridge, Massachusetts, during 24-29 June 1957. This issue brings under one cover a comprehensive and authoritative account of the main concepts and the various approaches made by several experts towards the solution or explanation of outstanding problems which yet remain to be solved in this comparatively new interfield discipline.

The nature, formation, structure and dynamics of cosmical gas bodies are discussed in a number of sections. The first section deals with the empirical studies of velocity fields in, and related structure of, the interstellar medium. The second section is devoted to theoretical considerations of the production and dissipation of velocity fields in interstellar medium. The cooling and condensation of interstellar matter and the kinematics of gaseous envelopes form the subject matter of the next two parts. Various aspects of the conditions at the ionization and shock fronts in collision of gas clouds are treated in the next chapter. In the subsequent chapter are included papers considering some general gas dynamical problems, e.g. hypotheses on the mechanism of stellar outbursts, mathematical structure of turbulence, distortion of a toroidal field by convection, shock waves in magneto-gas dynamic turbulence and hydromagnetic simulation of cosmical phenomena in the laboratory. The last chapter summarizes the whole proceedings and includes overall impressions of the various participating scientists, in the light of the entire discussion which took place at the symposium.

For the expert, the publication is a valuable reference work, and contains many original contributions. At the same time, the summaries provide the scientific ' layman ' with excellent and authoritative accounts of the current position and main concepts in this rapidly developing field.

Delineation of domain structure in crystals

A NEW POWDER PATTERN TECHnique for delineating the domain structure on the surfaces of a wide variety of crystals, e.g. ferroelectric, piezoelectric, pyroelectric, in which domains have never been observed before, is described [*News from Bell Telephone Laboratories*].

The new technique uses colloidal suspensions of electrostatically charged powders in an insulating organic liquid. When a few drops of this suspension are applied to the face of the crystal, the charged powder is immediately attracted to the ferroelectric domains carrying an opposite charge, and covers their entire area. The most effective materials for brightly coloured delineation are commercial spray-grade sulphur and red lead oxide, each suspended in hexane. The sulphur deposits on negatively charged domains, while the lead oxide deposits on the positive ones. Each of the suspensions is applied separately; the second is not applied until the hexane in the first has evaporated. If the two suspensions mix on the crystal surface, each may lose its charge. In this event, no pattern is formed. The powders are fixed in place indefinitely by their electrostatic charge after the hexane evaporates. A dispersion of a cross-linked polymer derived from polystyrene can also be used as the negatively charged colloid, in place of the lead oxide. This can be dyed in any desired colour with an oil-soluble dye.

The basis of the new technique is the fact that although the colloid as a whole is electrically neutral, individual particles acquire a diffuse, double-layer charge when brought in contact with the liquid. Under the influence of the ' built-in ' electric field, the colloidal particles are attracted either to the positive or negative domains depending on the orientation of their dipole layers. An insulating liquid of low viscosity and low dielectric constant such as hexane is desirable so that the charged particles are free to move toward the ferroelectric domains under maximum electrostatic attraction.

Powder patterns of an entirely different nature result if a colloid of finely divided barium titanate in hexane is used instead of sulphur and lead oxide. The barium titanate particles carry no net electric charge, but they do have a very high dielectric constant. Thus, when they are placed on the surface of a ferroelectric crystal containing positive and negative domains, the particles polarize in the external electrostatic fields and are deposited at domain boundaries where large field gradients exist. The resulting powder patterns outline the domain boundaries well, but do not differentiate between positively and negatively charged domains.

This new technique has provided the first information available on the domain structure of a number of crystalline ferroelectric materials, including triglycine sulphate and guanidinium gallium selenate hexahydrate. Previous optical determinations, which have been made on Rochelle salt, and domain etching procedures on barium titanate have also been confirmed by the new method.

Acoustoelectric effect in germanium

A BETTER UNDERSTANDING OF SEMIconductor materials has been obtained from studies on the ' acoustoelectric effect ' in germanium by scientists of the Bell Telephone Laboratories, New York.

The 'acoustoelectric effect' manifests itself as the induction of a direct current in a semiconductor under certain conditions by passing acoustic waves through it. An acoustic wave travelling through a semiconductor tends to produce a net force acting on the charge carriers in the direction of propagation of the wave. To offset this force, an electric field is induced in the semiconductor material, and this field can be measured by attaching contacts along the length of the sample.

Since this effect depends on some bunching of the carriers, it is normally reduced greatly by their mutual electrostatic repulsion. There are some situations, however, in which more than one type of carrier is present, and it is possible to bunch each type separately without developing a net space charge. This is the case with n-type germanium, in which the electrons belong to a band which has a number of distinct energy minima or ' valleys '. The electrons in the vicinity of these various valleys react differently to the acoustic wave, giving rise to the acoustoelectric effect. The magnitude of this effect gives a measure of the intervalley scattering time, i.e. the mean transition time between the separate groups of states in the conduction bands which lie near the minima of energy (valleys).

Experimental verification of the acoustoelectric effect has been obtained by passing acoustic waves at frequencies in the range 20-60 Mc/s. through a bar of n-type germanium, and measuring the voltage induced along the bar. To minimize stray effects, the acoustic waves are modulated with an audio frequency, thus producing an audio frequency induced voltage rather than a d.c. voltage.

The results of studies on intervalley scattering showed that this scattering is due in part to phonon scattering and in part to impurity scattering. These two effects may be separated, as the phonon effect becomes greater at higher temperatures (above 100°K.) while the impurity effect is predominant at temperatures below about 60°K. Between 60° and 100°K., the two effects are mixed [*News from Bell Telephone Laboratories*].

Vitron — a new concept of glassy state of matter

A NEW CONCEPT OF THE ATOMIC structure of matter in the glassy state, which is in accord with the available data on the unique properties of glass, has been suggested by the research workers at the U.S. National Bureau of Standards. This concept is based on a structural unit called the ' Vitron '. This new concept, if corroborated, would help to reconcile current hypotheses on the structural differences between the glassy and the crystalline states of matter.

The vitron is envisaged as a sub-microscopic cluster of pentagonal dodecahedra with sub-units of silicon-oxygen tetrahedra. Because of their pentagonal shape, the dodecahedra can be fitted together only when slightly distorted and this ultimately limits the size of the cluster. In the proposed model, the clusters are loosely joined together by ' connective tissues ' that have weaker bonds but greater densities than the vitron.

Present theories of glass structures view the atomic arrangement and interatomic distances of nearest neighbours in a glass and in its closely related crystal as being similar. However, in glass, the many slight irregularities, cumulated over relatively long distances (on an atomic scale), are believed to introduce a randomness masking the periodic characteristic of crystals. The extent of orderly arrangement in the vitron concept is greater than in other hypotheses but some randomness is retained, especially in the regions where the connective tissues unite the clusters. Under the vitron concept glasses and crystals may be expected to differ more fundamentally because of the difference in their structural symmetries. Theoretically growth in crystals can proceed indefinitely without stress while in the case of the vitron — because of its five-fold non-crystal symmetry — it is automatically limited by ever-increasing distortional stresses. The vitron concept also explains the reversible volume changes in silica glass produced by annealings at different temperatures as due to a temperature sensitivity of the bond angles, contrary to the other theories which attribute them to stretching, or breaking and reforming, of the bonds.

Evidence in support of the concept is given by analyses of property-composition curves for solubility, chemical attack, volatilization, molar volume and electrical resistance, and from differential diffraction studies of alkali silicate binary glasses [*Tech. News Bull., Nat. Bur. Stand.*, **42** (1958), 236].

New concepts in power reactor design

TWO NEW CONCEPTS IN THE DESIGN of nuclear power reactors have been envisaged and are being put into practice by scientists of the Westinghouse Electric Corporation.

One design involves the use of thermoelectric materials in the reactor fuel elements to convert the nuclear heat directly into electricity. The Westinghouse Research Laboratories have recently discovered a new, essentially unexplored class of such thermoelectric materials which can operate at temperatures of 2000-3000°F. Simplicity of design and construction, efficiency of operation, elimination of moving parts and noise are the outstanding advantages of direct conversion. Production of electricity within the fuel elements themselves eliminates the necessity of a steam cycle and results in reduction of space which is desirable in propulsion systems and special military requirements. The element will be a flat plate with electrical connections at each end. The nuclear fuel, serving as the heat source, will be completely clad with stainless steel to prevent spread of radioactive products. The thermoelectric material will surround the nuclear fuel.

In the other design, the organic moderated fluid bed reactor, instead of the usual movable control rods and fixed fuel elements, small marble-sized fuel pellets will be used. The fuel pellets will be kept in a large cylindrical container, open at the top, and with fluid-flow holes in the bottom. The reactor vessel will be surrounding this container. Before start-up, the fuel pellets rest in a settled, packed bed. With proper choice of fuel enrichment and pellet size, it will be ensured that no chain reaction takes place in this condition. The chain reaction can be started by increasing the flow of oil thus lifting the pellets and dispersing them uniformly throughout the fluid. The speed of the chain reaction may be controlled by controlling the oil flow [*Mech. Engng*, **80** (1958) (12), 80].

Mixing of powdered materials

AN EQUATION FOR EVALUATING THE degree of mixing together of two or more powders, in terms of the various parameters directly calculable from the physical properties of the elements of the system, has been arrived at as a result of an analysis based on published data. Though empirical, the new and extended equation fits well the experimental results of many workers over a much wider range than the earlier expression (of the type $M = 1-e^{-kt}$) based on an analogy of the process of mixing with diffusion. The new approach suggests that many of the relationships are simple and further experimental investigation has thrown more light on the mechanism of mixing and on the characteristics of the various types of machines used. The equation arrived at is:

$$M=\eta[1-\{(1-B/A)e^{-At/2}+B/A\}^2]$$

Parameter A has the dimensions T^{-1} and is expected to depend on: the diameter (D) and speed of rotation (N) of the mixer, the mean diameter (d_m), mean coefficient of friction (f_m) of the particles composing the mixture and the acceleration due to gravity (g). Similarly, the parameter B is expected to depend on D, N, d_m, the difference (Δd) of the mean sizes of the two components of the mix, the mean density (ρ_m) of the mixture and on the difference ($\Delta \rho$) of the densities of the two components of the mix. Dimensional analysis has indicated the following relations for A and B:

$$A \propto N \times \Psi_1(D/d_m) \times \Psi_2(N/N_c) \times \Psi_3(f_m)$$

where Ψ denotes some function of the variables and

$$B \propto N \times \Psi_4(D/d_m) \times \Psi_5(N/N_c) \times \Psi_6(\Delta\rho/\rho_m) \times \Psi_7(\Delta d/d_m)$$

The fit between the calculated and experimental curves is quite good, indicating the validity of the treatment.

A and B increase with increase in N. The rate of mixing and 'demixing' both increase with N but the value of B/A is independent of N showing that the maximum possible degree of mixing (η) and the equilibrium mixing (M_e) that could be attained in a machine are nearly independent of the speed of rotation. It is also evident that the rate of mixing is proportional to the power absorbed per unit mass of mixer charge. The intrinsic efficiency of the machine, which is a function of the geometry of the machine, does not vary much with the ratio of the diameter of the particles in the two components. Studies on mixers with different conical angles for the hopper and different orientations of the axis of rotation with respect to that of the mixer cylinder and the degree of roughness of the surface on which the mixing takes place have led to the following conclusions: When the surface on which mixing takes place is rougher, radial mixing is not significantly altered but rate of axial mixing is increased by 50 per cent; the power demand also increases by 80 per cent. Hence, the rate of mixing can be expected to vary as the square root of the linear dimensions of the machine [*Chem. Age*, **80** (1958), 1025].

Estimation of sulphur

A METHOD FOR THE ESTIMATION OF minute quantities of sulphur (1-2·5 mg.) in coal and certain organic compounds is reported. The sample is decomposed by the Carius procedure and the excess of nitric acid is evaporated. The sulphate is then precipitated by the addition of 4-amino-4′-chlorodiphenyl and the residual concentration of the reagent determined spectrophotometrically. The method gives recoveries within 1 per cent of theoretical for sulphate in the range of 3-7·5 mg.

The substance is heated with 1·25 ml. of nitric acid (d., 1·42), containing 25 mg. per ml. of sodium chloride, in a small sealed tube for 3 hr at 280°C. The solution is then evaporated to dryness in a current of dry air, the residue dissolved in 0·1N hydrochloric acid and this solution diluted to 25 ml. with the same acid (solution A).

To 10 ml. of this solution are subsequently added 15 ml. of 4-amino-4′-chlorodiphenyl (0·8 per cent in 0·1N hydrochloric acid) and a trace of Cetavlon (cetyltrimethylammonium bromide). After shaking, and standing for 2 hr, about 10 ml. of the supernatant is removed and centrifuged at 2000 r.p.m. Five ml. of this solution is diluted to 100 ml. and subsequently 5 ml. of the new solution is diluted to 50 ml. (solution B).

The optical density (I') of solution B is measured in a 1 cm. cell at 254 mμ against a blank solution prepared by diluting 1 ml. of solution A directly to 500 ml. All dilutions are made with distilled water.

The percentage of sulphur is calculated from the formula:

$$S = \frac{(I-I')\times 32\times 6250}{\epsilon \times \text{wt of sample (mg.)}} \times 100$$

where I is the 'sulphate blank' value determined for each batch of reagent solutions by means of a separate blank experiment, and ϵ the molar extinction coefficient of the reagent at 254 mμ [*Talanta*, **1** (1958), 142].

Detection of calcium

A METHOD FOR THE DETECTION OF calcium in pharmaceutical products using Schiff's base is reported. When an ethanolic solution of Schiff's base is added to a sample containing calcium and the solution made alkaline with sodium hydroxide, a red precipitate is formed. This precipitate is easily differentiated from similar precipitates formed by barium and strontium as the last two are destroyed by addition of sodium carbonate.

For the preparation of the reagent 4·4 g. of freshly sublimed *o*-aminophenol are dissolved in 1 litre of water at 80°C. and 3·0 g. of 40 per cent glyoxal, in water, are added. The solution is maintained at 80°C. for 30 min. and then left in the refrigerator for 12 hr. Finally it is filtered, the precipitate is washed with water and recrystallized from methanol.

The test procedure is as follows. One drop of the acid or neutral test solution contained in a micro test tube is treated with four drops of reagent (saturated solution in ethanol), one drop of sodium hydroxide solution (10 per cent), one drop of sodium carbonate (10 per cent) and extracted with three or four drops of chloroform. A few drops of water are added to hasten separation of the layers. Calcium is indicated by a red colouration in the chloroform layer. A blank test should be run.

In the presence of cobalt, cadmium, copper and nickel, one drop of a solution containing 10 g. each of sodium hydroxide and potassium cyanide in 100 ml. of water is used in place of sodium hydroxide alone [*Analyt. chim. Acta*, **19** (1958), 437].

Synthesis of protenoid compounds

THERMAL COPOLYMERIZATION OF amino acids has resulted in the production of true protenoid compounds. A critical feature of producing such protenoids is the employment of considerable molar excess of dicarboxylic amino acids, either aspartic or glutamic acids.

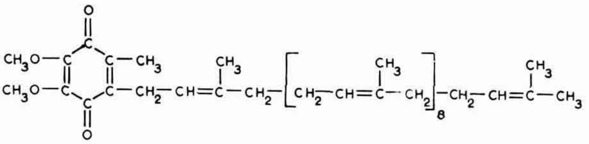
For the preparation of protenoid, 2·0 g. of L-glutamic acid is heated for 1 hr in an oil bath at 170°C., and into this melt is stirred a finely ground mixture of 2·0 g. of DL-aspartic acid with 1·0 g. of an amino acid mixture used for microbial assay. The mixture is then heated for 3 hr under a blanket of CO_2 in the oil bath at 170°C. After allowing to cool, the resultant mass is vigorously rubbed with 20 ml. of water which converted the product to a granular precipitate. This is allowed to stand overnight and then filtered and washed with 10 ml. of water and 10 ml. of ethanol. The solid is dialysed in a cellophane bag against water for 4 days. Yields, by weight, were usually much in excess of 15 per cent. A chromatogram of a hydrolysed sample of the clear soluble fraction of non-diffusible protenoid had the same pattern on chromatographing, i.e. has the R_f's of all the amino acids except tryptophan, which is found in the unhydrolysed product. The polypeptide nature of the polymer is substantiated by biuret tests and infrared analysis [*Science*, **128** (1958), 1214].

Role of coenzyme Q

INVESTIGATIONS CARRIED OUT AT the Institute of Enzyme Research, University of Wisconsin, Madison, U.S.A., by Dr D. E. Green and his associates, in which two Indian biochemists, Dr T. Ramasarma and Dr K. S. Ambe, have also taken part, have revealed that coenzyme Q, isolated from the lipids of beef heart mitochondria, is a new member of the electron transport system of mitochondria [*Biochem. biophys. Acta*, **25** (1957), 220 and *Proceedings, Fourth International Congress of Biochemistry*, Vienna, 1958].

During the course of an examination of the lipids of beef heart mitochondria, a crystalline yellow-orange coloured component, m.p. 49°C., which exhibits an ultraviolet absorption spectrum with a peak at 275 mμ ($E^{10\%}_{1\,\text{cm.}} = 165$), was isolated. The yellow colour of the compound in ethanol gets bleached on the addition of potassium borohydride and the spectrum of the bleached solution shows a new peak at 290 mμ ($E^{10\%}_{1\,\text{cm.}} = 46{\cdot}4$). This observation suggested that the compound may be a quinone (hence it is called coenzyme Q, where Q stands for quinone) and led to a series of investigations for adducing evidence to show that the compound is a member of the electron transport system of mitochondria.

The compound has the formula $C_{59}H_{90}O_4$ (mol. wt, 863) and the following structure has been assigned to it:



Another compound called ubiquinone, a quinone occurring ubiquitously in nature, found by R. A. Morton and co-workers, University of Liverpool, England, has also been shown to have similar structure as coenzyme Q; this has been confirmed by workers at the laboratories of Hoffmann-La Roche, Switzerland.

Beef heart mitochondria reduces coenzyme Q in the presence of succinate and oxidizes the reduced compound formed in the presence of air. It has also been observed that on extracting mitochondria in the presence of air, coenzyme Q is obtained in the oxidized form and when extracted in the presence of succinate it is obtained in the reduced form. This indicates that coenzyme Q undergoes oxidation and reduction during electron transport in mitochondria. Extraction of mitochondria with iso-octane results in the extraction of coenzyme Q with concomitant loss of succinate oxidation properties, and when it is replaced, the activity is restored. Thus coenzyme Q undergoes oxidation and reduction during electron transport in mitochondria and behaves like a cofactor in succinate oxidation.

New potentiation effect of cocaine

A NEW AND ENTIRELY UNEXPECTED potentiating effect of cocaine, which has been hitherto considered only as an adrenergic potentiator, has been observed on acetylcholine responses, where it acts as an apparent *in vivo* cholinesterase inhibitor. In an experiment on cats anaesthetized with α-chloralose (80 mg./kg.) it was observed that cocaine produced a potentiation of the acetylcholine induced contraction of the nictitating membrane even when no acetylcholine response was observed on the nictating membrane prior to the administration of cocaine. Cocaine also augments appreciably the effects of small doses of acetylcholine on the heart rate and blood pressure.

Several hypotheses have been suggested for the role of cocaine as potentiator of cholinergic neurohumor but the most likely explanation is that cocaine changes the permeability of membrane to ions, thus enhancing the action of the stimulating agent [*Science*, **129** (1959), 151].

Arrangement of nucleotides in RNA

A DEFINITE ADVANCE IN OUR knowledge of the complex structure of nucleic acids has been made by K. K. Reddi at the Virus Laboratory, University of California. By digesting nucleic acids with an enzyme, which attacks only a specific linkage, it has been possible to establish the arrangement of the nucleotides in portions of the nucleic acid chain. It also provides chemical basis, for the first time, that differences in biological activities of nucleic acids from different sources are connected with the differences in the arrangement of the pyrimidine and purine nucleotides along the chain. The information thus obtained may lead to a better understanding of the mutation process. It should also provide a rational basis for modifying the nature of a virus by reshuffling the arrangement of nucleotides in its nucleic acid part.

Digestion of nucleic acid molecules, from tobacco mosaic virus, with pancreatic ribonuclease and examination of the digestion products reveal that purine and pyrimidine nucleotides occur in clusters of two or more as well as alternating with each other. There is a certain regularity in the mode of arrangement of both the purine and pyrimidine nucleotides. Three dinucleotides and one trinucleotide in the ribonuclease digest have also been identified. Since each of these must be preceded, in the chain, by a monopyrimidine nucleotide, the existence of specific three- and four-unit sequences is thus established. These sequences account for more than 70 per cent of the known content of pyrimidine nucleotides and about half of the content of purine nucleotides. The presence of seven different dinucleotide sequences has also been demonstrated. Three strains of tobacco mosaic virus have been shown to contain different amounts of at least three of these dinucleotides [*Chem. Engng News*, **36** (47) (1958), 41].

High amylose starch

A NEW KIND OF STARCH CONTAINING 55 per cent amylose has been developed jointly by the American Maize Products and National Starch, U.S.A. Called Amylomaize I, the starch is made from a new kind of corn (amylose content, 82 per cent). The strain of high amylose corn produces more amylose than does the strain of conventional corn. The amylose can be extracted from the starch with butyl alcohol and other polar solvents or by using inorganic salts.

The starch is claimed to find application for making rigid gels, soluble wrappers for frozen foods, meats, etc., as a permanent fabric finish, and as a binding agent between pulp fibres in paper manufacture [*Chem. Engng News*, **36** (50) (1958), 54].

High-purity water by ion exchange

WATER OF HIGH PURITY CAN BE obtained conveniently and economically by using a mixed-bed ion-exchange column, provided certain precautions are taken. Water thus obtained is free from traces of colloidal electrolytes derived from anion-exchange resins and minute traces of organic nitrogenous matter.

Fresh resins as obtained from manufacturers should not be used. In particular, the anion-exchange resin should first be eluted and then alternately regenerated with caustic soda and exhausted with sodium chloride solution two or three times. In this way, degenerated nitrogenous materials remaining on the resin from the manufacturing process are removed. The cation-exchange resins should be similarly treated by passing them through the hydrogen-sodium cycle. After complete regeneration the resins should be thoroughly washed with distilled water (100 gal./cu. ft anion resin and 75 gal./cu. ft cation resin) at a flow rate of 0·5 gal./cu. ft/min. and then intimately air-mixed in the proportion of 2 anion resin : 1 cation resin, by volume.

The column should be of polyethylene, Perspex or Pyrex (not soda glass) and should be not less than 3 in. in diameter. A minimum depth of bed of 24 in. should be used. In a narrow column the resin-glass interface surface-volume ratio is poor and in a short column the contact time at the optimum flow rate is inadequate. The bottom filter should be of close-woven nylon or of a similar material, or else consists of a No. 1 porosity sintered Pyrex disc.

The effluent should be passed through a further small column containing sulphonated polystyrene resin in the hydrogen form cross-linked 1-2 per cent. Alternatively, the filter may take the form of a Pyrex or polyethylene tube loosely packed with platinum wool maintained at a high negative potential above earth.

The cation resin filter will remove such undesirable components mentioned above either by surface effect or by ion exchange, with the production of water. Colloidal particles of anionic resin will tend to be similarly adsorbed. Such particles will also be attracted to and retained upon a negatively charged surface [*Nature, Lond.*, **182** (1958), 1667].

Scientific conservation of materials — a symposium

AT A SYMPOSIUM ON 'SCIENTIFIC conservation of materials', organized by the Scientific Workers' Association, Ministry of Defence, Kanpur, during 1-3 February 1959, attention was focussed on the need for and importance of conservation of resources in the context of the increased demands made on them from all sectors due to the expanding industrialization under way in the country. The symposium, the first of its kind to be arranged by a trade union, was attended by scientific workers and technologists from all parts of the country. Over eighty papers were presented and discussed under nine technical divisions. Under the Chemicals Division, discussions were centred on the conservation problems in shellac and resin industry, vegetable oil and organic solvents. Food and Agricultural Division considered the development of local manurial resources, prevention of insect infestation, subsidiary food and application of principles of nutrition in the conservation of food resources. Important problems discussed by the Drugs Division related to the efficient preservation of different kinds of drugs. Improved utilization of textile raw materials, preservation of high strength fabrics, improvements in raw hides and skins, use of antioxidants to prevent aging of rubber, and reclamation of rubber from factory waste and from used rubber goods for re-use were considered in the Textiles, Leather and Rubber Divisions. The Timber Division discussed the conservation of timber through proper storage and new trends in timber structures. Steel economy, corrosion prevention and reclamation of used lubricating oils, maximizing the middle petroleum distillates and some aspects of efficient processing of crudes formed the topics for discussion in the Metals and Petroleum Products Divisions.

Salinity problems in arid zones

A SYMPOSIUM ON SALINITY PROBLEMS in arid zones, jointly organized by the Iranian Government and the Unesco, was held at the University of Teheran, during 11-15 October 1958. The symposium was attended by 83 specialists from 20 countries. Fifty-four papers were presented and discussed in the four sections of the symposium.

The discussions covered a number of subjects, like hydrology and salinity, plant and animal physiology, use of brackish water in irrigation with special reference to saline soils. Special attention was paid to the subject of demineralization of saline water to fresh water and to the various processes of saline water conversion in vogue in various countries. A survey of the activities of institutions engaged in research on saline water conversion to fresh water shows that vaporization processes are still receiving the greatest attention. The other processes in use are electrical, solar distillation and freezing. The greater attention that is being paid to research on vaporization processes is due to the availability of the commercial equipment and the production of highly pure water (4 p.p.m.) for industrial purposes by the commercial equipment. Several entirely new designs of evaporators have been tested in the laboratory and are now in the pilot plant stage. With a view to producing distilled water cheaply, a new, large compression distillation plant using centrifugal evaporator condenser units producing 95 cu. m./day and multiple effect evaporation combined with thermocompression using commercial long-tube vertical evaporators, are being tested in U.S.A. for the evaporation of sea water. Electrodialysis has been further developed and is reaching the commercial stage; two electrodialysis plants are being installed in Tobruk. Apart from methods to deal with scaling, a treatment has been developed to reactivate membranes whose electrical resistance has increased considerably.

Lending Library for Science and Technology

A NEW NATIONAL LENDING LIBRARY for Science and Technology, being organized by the Department of Scientific & Industrial Research at Thorp Arch, Yorkshire, England, will begin operating in 1961 and will become fully operational during the following year. The Library will make its unique collection available to research, industrial, educational and other organizations by loans and photographic reproduction. The primary objective of the Library will be to encourage the greater use of scientific and technical literature. Another important activity will be the expansion of work on the translation of Russian scientific literature, now being organized by the Lending Library Unit — the nucleus for the new Library being organized — in collaboration with the U.S. National Science Foundation. The Library will cover all subjects in science and technology, except for some fields of medicine. It will be responsible for running the lending service now provided by the Science Museum Library and making it comprehensive in future.

International course in hydraulic engineering

THE THIRD SESSION OF THE INTERNATIONAL Course in Hydraulic Engineering, jointly organized by the Delft Technological University and the Netherlands Universities Foundation for International Co-operation, begins on 21 October 1959 at Delft, Netherlands. It will last for 11 months, with four one-week intervals for holidays. The medium of instruction is English.

Arrangements have been made to enable each participant to adapt the programme to his personal requirements. The programme allows a choice between three alternative branches of study: (1) Tidal and Coastal Engineering (including Harbours), (2) Rivers and Navigation Works (including Groundwater Recovery), and (3) Reclamation.

Opportunities will also be provided to visit and study the extensive Dutch hydraulic engineering projects which are now under construction or will be launched in the next few years.

Prof. T. Th. Thijsse, Director of the Hydraulics Laboratory at Delft, is the general adviser of the course.

A Diploma in Hydraulic Engineering will be awarded to those who make sufficient progress during the course.

Applications should be addressed to the Netherlands Universities Foundation for International Co-operation, 27 Molenstraat, The Hague, Netherlands.

Technical Manpower

THE NATIONAL REGISTER OF Scientific & Technical Manpower, set up under the auspices of the Council of Scientific & Industrial Research, New Delhi, has recently started the publication of a monthly bulletin under the title *Technical Manpower* for disseminating up-to-date information on Indian technical and scientific personnel inside the country and abroad. The bulletin will also notice in its columns other problems relating to scientific and technical manpower.

The National Register, originally established in 1948 by the Government of India, was reorganized in 1957-58 with the following objectives: (1) To provide comprehensive and authoritative information on national resources of scientific and technical manpower; (2) to serve as a clearing house for information on resources of and requirements for scientific and technical manpower; (3) to develop a special section of the Register to maintain current information on Indian nationals studying or working in technical fields in foreign countries; (4) to provide information on individuals having highly specialized training and experience, when an appointing authority finds it difficult to get suitable candidates to respond to public advertisements; and (5) to assess the gaps in the training and utilization of scientists and technologists through technical manpower research.

The National Register has already collected a large volume of data, which, after analysis and classification, will be made available through the medium of this bulletin.

Soviet research publications

Fused salts — ENGLISH TRANSLATIONS of 42 papers reporting Soviet researches on fused salts, which originally appeared in 1956 issues of various Soviet chemical journals, have now been published in two parts by the Consultants Bureau Inc., New York. The two volumes together are priced at $ 40.00. Part I (price $ 30.00) includes 23 phase diagram studies of binary, ternary and quaternary reciprocal system. Part II (price $ 20.00) contains 19 reports on the electrochemistry of aluminium and magnesium, corrosion, slags and theoretical aspects of fused salts research including thermodynamics. Tables of contents listing the 42 reports are available without charge from the publishers.

Glass and ceramics — English translations of 63 papers covering Soviet research in glass and ceramics during 1956 have been published by the Consultants Bureau Inc., New York.

The collection, *Soviet Research in Glass and Ceramics*—1956, consists of three sections: Basic Science (38 papers), Glass, Glazes and Enamels (10 papers), and Cements, Limes and Plasters, Refractories, Miscellaneous (15 papers). The entire collection is priced at $ 40.00. All the papers translated were originally published during 1956 in Soviet chemical journals, some of which are: *Journal of General Chemistry, Moscow*; *Journal of Applied Chemistry, Leningrad*; *Journal of Analytical Chemistry, Moscow*; and *Bulletin de l'Academie des sciences de l'U.R.S.S.* All diagrammatic, tabular and photographic material integral with the text is also included in the collection.

Dechema-Werkstoff-Tabelle

THE LATEST (EIGHTH) IN THIS series published by Deutsche Gesellschaft Für Chemisches Apparatewesen covers data on the chemical resistance of about 100 constructional materials to 46 corrosive substances including substances like glycerine, glycol, potassium chloride, urea, potassium and potassium alloys, potassium bichromate and potassium nitrate. The *Dechema-Werkstoff-Tabelle*, a standard work of reference, will ultimately consist of a total of 1200 pages of which 800 have already been published. The price is DM 40 per instalment of 100 pages. Full particulars of the *Tabelle* are given in a pamphlet which may be obtained free of charge from Dechema, Frankfurt (Main) 7, Post fach.

Announcements

- *Waverley Gold Medal Essay Competition,* 1959 — Applications are invited for the competition designed to encourage and promote improved and more effective reports of scientific and technical work. A gold medal together with a cash prize of £ 100 will be awarded for the best essay describing a new scientific project or practical development, giving an outline of the scientific background, experimental results and potential application of the project or process in industry (diagrams and photographs may be included). The essays will be judged both for their technical content and clarity of presentation and style. A second prize of £ 50, and a special prize of £ 50 for the best entry from competitors under the age of 30 years on 31 July 1959, are also offered. The competition is open only to persons engaged in scientific work from 1st January to 31 July 1959. The essay should be written in English and should be of about 3000 words in length. Joint entries by not more than two competitors may be submitted. Entries should reach the Editor, "Research", 4/5 Bell Yard, London W.C. 2, not later than 31 July 1959.

- *Murchison Grant for* 1959 — The Council of the Royal Geographical Society, London, has awarded the Murchison Grant for 1959 to Dr S. P. Chatterjee, Director, National Atlas Organization and Head of the Department of Geography, Calcutta University, for his work in organizing and directing the National Atlas of India. The award will be presented at the Society's Annual General Meeting on 15 June 1959.

The preliminary edition of the National Atlas of India in Hindi was published in October 1957 and is a collection of 26 sets of specialized maps depicting India's physical features and socio-economic distributional patterns. The maps for the English edition, which are under preparation, will contain 180 plates on scales ranging from 1: 1,000,000 to 1: 16,000,000.

- *L.T.M. Examination, Calcutta University* — The School of Tropical Medicine, Calcutta, has introduced a three months' course of instruction, open to medical personnel only, for the L.T.M. examination, beginning from 15 July 1959. Applications for admission in the prescribed form should reach the Director, School of Tropical Medicine, Calcutta, by 14 May 1959.

- *Award of Doctorate Degrees* — The following have been awarded the Ph.D. degree of the Delhi University for the respective theses noted against their names in parentheses: Shri Prem Sagar Sarin (*Analytical and synthetic studies of naturally occurring flavonoid derivatives*); Shrimati Vimla Negi (*Morphology and embryology of Gnetum ula Brongn*); and Shri Indera Paul Singh Monga (*The inheritance of finger ball patterns*).

Shrimati P. B. Padmavathi has been awarded the Ph.D. degree of the Mysore University for her thesis entitled, *Contribution to our knowledge of the cytology and cytochemistry of Ciliata: Protozoa.*

Shri D. N. Sitharamarao has been awarded the Ph.D. degree of the Poona University for his thesis on *Diffusion of ions in solution.*

INSTRUMENTS AND APPLIANCES

New projection microradiograph

A NEW NORELCO PROJECTION MIcroradiograph (Fig. 1), designed for X-ray microscope techniques and other applications in metallurgical, rubber, plastics, mineralogical, agricultural, pharmaceutical and biological fields, is available from

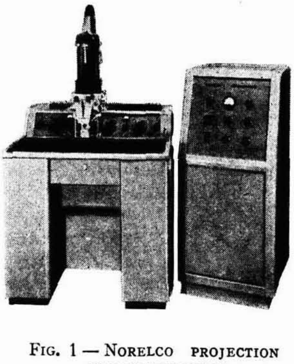


FIG. 1 — NORELCO PROJECTION MICRORADIOGRAPH

the Instruments Division, Philips Electronics Inc., Mount Vernon, N.Y.

The unit employs an X-ray source (voltage on tube, 2-50 kV. and continuously variable) approximately one micron in size to produce enlarged images of specimens (up to $\frac{5}{8}$ in. can be accommodated) placed close to the radiating surface. Contrast is controlled to some extent by varying the accelerating potential of the electron beam and by changing target materials.

The electron-optical system includes an electron gun, high voltage source for electron acceleration, electromagnetic lenses to control beam size and configuration, and six targets having surface planes normal to the beam at the end of its path and which can be changed by means of exterior controls.

The new instrument permits critical evaluation of opaque specimens and is invaluable as an aid in light and electron microscope work. Stereo-micrography, absorption analysis, change of target materials during operation, and choice of vacuum or air in the specimen chamber are features of the new unit which permit routine handling of difficult problems.

Sharp, clear images are observed on a viewing screen and are recorded with a camera that accommodates five exposures on a 2 × 10 in. plate. Exposure time is approximately 1 min. at 10-12 kV. Resolution is 1·0 μ or better at 2-20 kV. Direct magnifications up to 70x are possible on the photographic plate and up to 250x on the viewing screen-binocular combination. The total useful photographic enlargement is 1500x and the field of view at 2x magnification is approximately 15 mm. and at maximum magnification is about $\frac{1}{2}$ mm.

The new instrument consists of two cabinets. The main unit is 37 in. long, 74 in. high, 26 in. deep, and weighs approximately 750 lb. The control cabinet is 24 in. wide, 50 in. high, 24 in. deep and weighs 175 lb. The unit requires an a.c. power supply of 1 kVA. at 250 or 440 V., 60 c/s.

Apparatus for study of oxidation rate

An apparatus suitable for obtaining continuous automatic records of oxidation rates in processes where oxygen is continuously absorbed for periods of over 8 hr has been described.

The apparatus consists of an absorption cell, oxygen generator and two recording devices. The sample under test (0·1 g.), is dispersed on 25 sq. cm. of filter paper and placed in the absorption cell. The apparatus is flooded with oxygen from a cylinder and assembled. As oxidation proceeds the pressure within the system falls. This pressure fall actuates via a salt solution manometer, the electronic relay which switches on the current to the electrolysis cell, integrating counter and recorder. Oxygen liberated at the anode re-establishes the pressure, which, via the manometer and relay, breaks the circuit. The 4 V. fed to the counting device may directly operate a low-voltage motor coupled to a counter, or alternatively, a low-voltage relay which switches mains voltage to a servo motor coupled to a counter. The counting device allows an accurate measure of the total operating time of the electrolysis cell, while the recorder indicates the individual periods of operation with respect to time.

The apparatus has been used to study the oxidation rates of non-drying vegetable oils at atmospheric pressure and at different temperatures [*Chem. Age, Lond.*, **80** (1958), 1056].

A versatile fractionating column

A new fractionating column with removable trays has been developed which can be readily adapted for all kinds of fractionation work. Its working is similar to that of a conventional perforated tray with downcomers, except that liquid intermittently drips downward through the holes provided for the vapour to pass upward. This principle has been used extensively in large-diameter commercial columns, but not in small-scale equipment. Six different types of trays have been tested with hole diameters ranging from $\frac{1}{16}$ to $\frac{1}{4}$ in. with open areas from 19 to 35 per cent; varying the tray spacing is possible in the equipment.

For applications requiring a large number of trays without much concern for high capacity, a low open-area tray at close tray spacing is suitable. If a simple separation with prime interest in high capacity is desired a high open-area tray at wide tray spacing is to be used. For pilot plant work where the column is required to have a constant number of theoretical plates over a considerable throughput range, a wide tray spacing is favourable. In an application where polymer formation is possible the $\frac{1}{4}$ in. holes would be ideal, and the large holes would also be used for aqueous systems or other high surface tension liquids. The 30 per cent open-area tray with $\frac{1}{16}$ in. holes, and the 25 per cent open-area tray with $\frac{1}{4}$ in. holes are adequate for most purposes [*Industr. Engng Chem.*, **50** (1958), 1671].

Progress Reports

JUTE RESEARCH

THE ANNUAL REPORT OF THE INDIAN CENTRAL JUTE Committee for the year 1956-57 reveals that the area under jute crop increased from 17·39 lakh acres in the previous year to 18·83 lakh acres during the year under review and the production of raw jute was 42·21 lakh bales as compared to 41·97 bales in 1955-56. The increase registered was partly due to increase in acreage under jute and partly due to growing better quality jute; the increase in production was, however, not commensurate with the increase in acreage due to adverse climatic conditions. Considerable data have been collected at the Jute Agricultural Research Institute from investigations relating to varietal, cultural and manuring trials and from studies on breeding, agronomical, mycological, entomological, genetical and pathological aspects of jute. This information is useful to jute growers in raising the production and improving the quality of jute.

A new pest of jute, *Agrilus acutus*, has been recorded for the first time on jute; it causes similar type of damage as in *H. cannabinus*. A 20-curie Co^{60} field source for gamma irradiation of oilseeds was acquired during the year and will be installed at the Jute Agricultural Research Institute. An experimental spinning plant for wool and woollenized jute was installed at the Technological Research Laboratories during the year.

Jute Agricultural Research Institute — The results of experiments on salt tolerance of jute plants have shown that *capsularis* varieties are more salt tolerant than *olitorius* ones. The wild species, viz. *C. siliquosus*, *C. tridens* and *C. trilocularis*, have been observed to tolerate 20 per cent salt concentration. Foliar application of nutrients like urea and ammonium sulphate has been found to give higher yields of fibre.

A new nitrogen fixing organism has been isolated from the soil of the Institute's farm. Seed inoculations with this new organism and with *A. chroococcum* (black strain) gave higher fibre yield. The rhizosphere effect has been observed in the case of *C. olitorius*. Application of ammonium sulphate and bone dust under cultivator's conditions, in ditches, proved effective in lowering the retting period and gave a fibre of better colour.

During trials to improve the quality of fibre obtained by 'stack retting' it was observed that during retting, 90 per cent of the pectins contained in the bark are removed but the quantity of hemicellulose removed was only 15-17 per cent. Of the bacteria isolated from the retting water, two were found to be active in decomposing pectins and two others in decomposing hemicelluloses. Some of the fungi are able to decompose both. Assessment of a number of cheap commercial fungicides in arresting the stem-rot disease, under field conditions, showed that oxides of copper are preferable to oxychlorides and thiocarbamates. Above 60 lb./acre, the incidence of diseases has been found to increase with increase of nitrogen; the action is independent of phosphate which can reduce incidence to a very limited extent.

A new fungus, tentatively identified as *Trichosphaeria* sp., has been found in association with the *Volutella* sp. which causes the 'brown-rot' of *H. cannabinus*. Singly, the fungus has also been found to cause severe tip-rot in the primary selections from different indigenous and foreign sources.

Technological Research Laboratories — A number of characteristics of jute of industrial importance like chemical characters, effect of delignification on acetyl groups of jute, nitrogen in jute, fractional dissolution of jute alphacellulose, etc., have been investigated.

Ten strains of bacteria and 3 strains of fungi, isolated from piles of softened roof-cuttings were, found to be ret-producing. A particular strain of *Aspergillus niger* showed maximum activity in softening the hard roots.

Using X-ray methods, the dimensions of the intermicellar regions and capillaries in raw jute fibre have been determined from the sizes of colloidal gold and silver particles deposited in the fibre and the influence of lignin and hemicelluloses on the formation of these particles has been investigated. It was observed that in jute, unlike in ramie, these particles were formed in capillaries much wider than the intermicellary regions, as they were blocked by non-cellulosic amorphous materials like lignin. The swelling of ramie fibres is quicker than that of jute because of the latter's higher lignin content. X-ray diffraction patterns of jute fibre taken at liquid oxygen temperature (−180°C.) reveal no major change in the state of crystallinity.

Exposure of treated raw and delignified jute filaments to ultraviolet light showed no adverse effect of the irradiation on the tensile, elastic and swelling characteristics. There was some reduction in substance strength and a fall in flexural elasticity after sufficiently long exposure.

A simple experiment was set up for measuring the thermal insulation value (T.I.V.) of a blanket on the basis of fractional reduction in heat from a hot cylindrical surface when covered with the blanket. The results are expressed as

$$\text{T.I.V.} = 1 - \frac{\text{heat loss with cover}}{\text{heat loss without cover}}$$

heat loss being measured under similar conditions in both cases.

Trials on 30 samples to study the effect of cutting the roots, a difficult but necessary procedure in mill practice, showed that the roots do not seriously affect the spinning quality; the difference in card waste from cut and uncut samples appears to be insignificant. Hence it is decided that no root, except very hard, unspinnable roots, should be cut in the standard spinning trial of the Jute Agricultural Research Institute samples. Blending of jute with 10 per cent of mesta fibre reduces the quality ratio of the yarn by 3 per cent, compared to that spun from jute alone; 2-3 per cent oil seems to be adequate for mesta processing, and with between 3 and 9 per cent there is no appreciable difference in the quality ratio of yarns; further increase in the amount of oil with proportionate reduction in water content reduces the quality ratio abruptly.

Choice of proper yarns and improvements made in the structural layout employing D.W. plain fabrics have resulted in the production of cement bags with satisfactory performance in respect of seepage and water absorption.

THE NUFFIELD FOUNDATION

THE ANNUAL REPORT OF THE NUFFIELD FOUNDATION for the year ended March 1958 reveals that significant results have been obtained in the various research projects sponsored by the Foundation, particularly in the biological sciences. Since its founding in 1943, the Foundation has made grants amounting to £ 8,500,000 to various universities and research institutions in U.K. and the Commonwealth countries of which £ 2,000,000 were devoted to projects concerning Commonwealth countries; in 1957-58, the grants totalled £ 850,000. For over a decade the Foundation has been devoting greater attention to promoting research in biological sciences, and during the period under review, the largest number of projects were under this head.

In the following paragraphs a brief account is given of the research work carried out under the various projects sponsored by the Foundation in the field of biological research.

In the project 'The mind and the machine', in progress at the University College, London, a study of the learning mechanism of the octopus has been made, and on the basis of the theory deduced from the study, a machine has been designed which could simulate a part of the mechanism of the octopus involved in the learning process. A computer with 30 units has been fabricated which is able to utter a sound of recognition when a shape which resembled the one it had previously learned to classify was put before its electronic eye. An analogue computer is being fabricated which will be trained to recognize shapes held in front of its model eye. The computer will be able to simulate the learning of the alphabet, the numerals and a limited number of more complex shapes, which might include human faces. The computer will also be able to deal with theories of colour vision.

Another project on 'Theory of learning' at the University of Oxford is concerned with investigations of mechanisms by which animals and human beings analyse stimuli, and in particular as to how visually presented shapes are analysed.

Investigations in progress at the University of Reading on 'insect brain' relate to the neural mechanisms underlying behaviour problems. Work on locusts has shown that they prefer certain visual forms to others, such as black figures on white ground. An attempt is being made to elucidate the structure of the optical ganglia and their connections and to relate their organization to behaviour. The outcome of this study will be of fundamental biological interest and, in addition, of immediate practical interest in locust control. Studies on the brain of wood ant have revealed that the lobes of *Corpora pedunculata* are concerned with the control of posture and movement of body and the appendages of the ant, and are important in optomotor reactions. Lesions between the optical ganglia and the *Corpora pedunculata* cause loss of memory.

From theoretical studies on physical aspects of behaviour in animals (certain electric catfish), it has been shown that the movements of a flagellum involves active changes along the whole length of the filament and it has been possible to assess the extent to which the inertia of a fish's body enables it to negotiate a current of water. A novel thermostat has also been designed for use in the study of water loss from insects.

Investigations on the structure of cells, with special reference to the structure and synthesis of coenzyme A and other nucleotide coenzymes, have led to new developments relating to the isolation and function of new nucleotides from micro-organisms. Two of these new nucleotides, which have been purified and their structures determined, have been found to participate in hitherto unsuspected metabolic routes involving glycerol and ribitol, a reduced sugar. These nucleotides are also concerned with the synthesis of a new type of polymer which is associated with bacterial cell walls. The discovery of a new polymer, and its location in the cell walls, would be of considerable importance in the understanding of the bacterial function and for developing a rational basis for chemotherapy.

A study of the absorption of metallic ions on cellulose has revealed the development of a two-dimensional metal-cellulose lattice which may lead to a method for the study of the surface of microfibrils.

In a study on hybrid vigour (heterosis), it has been observed that the hybrids grow normally and bear fruit under light energies that are one-quarter of the minimum light energies needed by the parents; as the hybrids do not exhibit marked heterosis under adequate light, this is particularly remarkable.

Significant contributions to the understanding of movement of gases and water vapour into and out of leaves have emerged from the investigations on gaseous exchange in leaves and on stomatal mechanism. Another discovery regarding the minimum concentration of carbon dioxide found in the air spaces in leaves opens up a new field of investigation concerning the interrelationship of photosynthesis, respiration and water balance.

Other research programmes supported by the Foundation relate to causes and treatment of mental deficiency which include: search for rare or hitherto unknown cases of metabolic disturbance, dietetic experiments with selected amino acids in cases of metabolic anomaly and chemical trials with biologically active substances (hormones); catalytic processes in biological reactions, particularly metal iron-catalysed reactions; photosynthesis; exchange of gases in plants; enzyme catalysed processes, etc.

Supplement

ABSTRACTS

of Published Research Papers from National Laboratories and Sponsored Research Projects of C.S.I.R.

OCTOBER-DECEMBER 1958

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ALPHABETICAL SUBJECT INDEX

ABSTRACTS

[For the classification of abstracts both the Colon and the U.D.C. systems have been adopted. The numbers on the left-hand side of the subject titles refer to Colon Classification while those on the right-hand side, to the U.D.C.]

C PHYSICS 53

C216 Crystallography 548.0 : 53

65. Biswas, S. G.: Crystal structure of chlorobenzene and bromobenzene at −180°C., *Acta cryst., Camb.*, **11** (1958), 882

The crystal structure of chlorobenzene and bromobenzene frozen and cooled to −180°C. has been studied by means of Debye-Scherrer photographs and from the analysis both the crystals have been found to belong to the orthorhombic system. The unit cell dimensions for chlorobenzene are: $a = 13{\cdot}72$, $b = 11{\cdot}32$, and $c = 7{\cdot}75$ A. and those for bromobenzene are: $a = 14{\cdot}30$, $b = 11{\cdot}48$, and $c = 7{\cdot}5$ A. The densities of the crystals have been found to be 1·225 and 1·654 g./ml. respectively. The restriction of reflections shows that both substances belong to the space group Q_h^{13} having 8 asymmetric molecules per unit cell.

66. Goswami, A.: Electron diffraction study of epitaxial growth of silver deposits on sodium chloride crystals, *J. sci. industr. Res.*, **17B** (1958), 324

The results of electron diffraction study of epitaxial growth of silver deposits on sodium chloride crystals have been discussed. For both the reflected and the transmission patterns the deposits have been observed to develop $\{211\} + \{10\bar{1}0\}$ orientations in addition to the initial $\{100\}$ orientation.

67. Sinha, K. P.: On the quantum yield of colour centres in alkali halides, *J. sci. industr. Res.*, **17B** (1958), 379

The quantum yield for conversions $F \rightarrow F'$ or $F' \rightarrow F$ in alkali halides has been studied and an interpretation of the yield as a function of temperature and concentration is given. A theoretical expression has been deduced for the yield which is consistent with the experimental values.

68. Trehan, Y. N. & Goswami, A.: The thermal oxidation of Cu (111) and (100) faces, *Trans. Faraday Soc.*, **54** (1958), 1703

The thermal oxidation of Cu (111) and (100) faces in air in the temperature range 120-350°C. has been investigated. The initial oxide layer formed consists of cuprous oxide having an amorphous or a fine-grained structure. Increase in film thickness with temperature and/or time of oxidation results in the formation of crystalline Cu_2O grown epitaxially with a two-degree $\{111\}$ orientation on both the faces. With further increase in temperature or thickness, mixed two-degree $\{111\} + \{100\}$ oriented Cu_2O is formed and finally the top layers consist of randomly disposed or one-degree oriented Cu_2O. Above 200°C., with sufficient time of heating, CuO layers, two-degree oriented, randomly disposed, or one-degree oriented, are observed over the initial Cu_2O layers, the orientation being determined by the temperature of reaction. The appearance of forbidden reflections of Cu_2O crystals has been explained on the basis of dynamical scattering.

C5 : 3 Spectroscopy 535.33

69. Narasimha Murty, A.: Resonance absorption in paramagnetic salts, *J. sci. industr. Res.*, **17B** (1958), 470

Resonance absorption characteristics (the resonance field, half width, g factor and χ'') of manganese sulphate, manganese chloride, manganese acetate and chromium phosphate, determined by means of a specially developed technique, have been discussed.

C6 : 14 Dielectrics 537.311

70. GOPALA KRISHNA, K. V.: Dielectric relaxation — Effect of temperature, *Indian J. Phys.*, **32** (1958), 387

Dielectric relaxation times have been determined over a wide range of temperatures for benzophenone, ethyl benzoate, α-nitro-naphthalene and ethyl adipate dissolved in heptane and ethyl adipate in decaline. The results have been discussed in the light of Eyring's theory of dipole rotation.

71. MURTY, C. R. K.: Dipole moments of some substituted benzenes and pyridines, *Indian J. Phys.*, **32** (1958), 516

The dipole moments of seven substituted pyridines, viz. 2- and 3-acetyl, 2-amino-3-methyl, 2-amino-4-methyl, 2-amino-5-methyl, 2-amino-6-methyl and 2-amino-4-6-dimethyl pyridines, have been determined for dilute solutions in benzene. The values have also been calculated using group moments and vectorial method. The differences in moments between the calculated and the observed values have been discussed.

72. MURTY, C. R. K.: Dipole moments of some substituted benzenes and pyridines: Part II — Meta disubstituted benzenes, *Indian J. Phys.*, **32** (1958), 365

The dipole moments of *m*-fluorochloro, *m*-fluorobromo and *m*-fluoroiodo benzenes have been determined for dilute solutions in benzene. For meta compounds the values agree with those calculated by simple vectorial addition of the group moments, indicating the absence of induced effects.

73. MURTY, C. R. K.: Dipole moments of some substituted benzenes and pyridines: Part III — Chloro- and bromo-ethyl benzenes, *Indian J. Phys.*, **32** (1958), 492

The dipole moments of six ethyl substituted benzenes (*o*-, *m*- and *p*-chloro- and *o*-, *m*- and *p*-bromo-ethyl benzenes) have been determined for dilute solutions in benzene. The effects of methyl and ethyl groups on other substituents in the benzene ring have been discussed in the light of the observed moments.

74. MURTY, C. R. K., Study of variation of dielectric relaxation time with solvent, *J. sci. industr. Res.*, **17B** (1958), 441

Relaxation times of acetophenone, benzyl alcohol and aniline have been determined in dilute solutions in four non-polar solvents, viz. cyclohexane, benzene, carbon disulphide and *n*-hexane. The variation of relaxation time with solvent has been discussed in the light of the new approaches made recently for modifying Debye's equation.

75. VYAS, A. & SRIVASTAVA, H. N.: Dielectric behaviour of acetone, methyl alcohol and aniline in benzene at 9516 Mc/s., *J. sci. industr. Res.*, **17B** (1958), 377

Dipole moment and relaxation time have been determined for acetone, methyl alcohol and aniline in benzene at 9516 Mc/s. using the dilute solution method of Potapenko and Wheeler. Volumes of the orienting molecules have also been determined and compared with the theoretical values calculated from critical data. Good agreement is observed between the theoretical and the experimental values.

C7 *Magnetism* 538

76. LAKHBIR SINGH: A new approach to the diamagnetic anisotropy of benzene, *Trans. Faraday Soc.*, **54** (1958), 1117

It has been shown that if a suitable correction for the anisotropy of σ-electrons is applied, the calculated values of $\sqrt{\overline{r^2}}$ for the bigger π-electron orbit in benzene derivatives agree very closely with the geometrical radius of the benzene ring. A correction for the discrepancy between the values of K_1 and K_2 (diamagnetic susceptibility) in the plane of the nucleus has also been proposed.

D ENGINEERING 62

D321 : 32 Soil Mechanics 624.131

77. MEHRA, S. R. & NATARAJAN, T. K.: Settlement of foundation due to saturation of loessial subsoil, *J. Instn Engrs India*, **39** (Part I) (1958), 303

The causes of the unexpected and sudden settlement that occurs when the loess-like subsoil of a structure gets accidentally saturated have been investigated. A foundation design based on an allowable soil pressure for such materials at natural moisture content would be in considerable error if the subsoil subsequently becomes saturated.

78. SANKARAN, K. S.: Effect of initial strain on unconfined compressive strength of compacted silty clay, *J. Instn Engrs India*, **38** (Part I) (1958), 1099

The effect of initial strain on the unconfined compressive strength of samples of compacted clay soil has been studied. It has been found that the effect of pre-loading is smaller than chance variations between specimens, and 'multiple-stage' triaxial tests can be used for evaluating the strength characteristics of compacted silty clay.

79. UPPAL, H. L. & KAPUR, R. N.: Some preliminary investigations on the use of pressure cell for measuring load dispersion through soil, *Road Res. Bull.*, No. 5 (1958), 25

Some preliminary investigations on the dispersion of load through soil mass have been carried out by means of an inductance type of pressure cell. The results indicate that load transmission through soils is a function of (i) intensity of loading, (ii) density of soil, (iii) size of the loading plates, (iv) thickness of soil crust, and (v) moisture content of the soil. The calculated and the experimental values agree for a density of about 1·5 and moisture content of 5-6 per cent.

D411 *Road Engineering* 625.7

80. JAGUS, P. J. & SETHI, K. L.: Use of membranes for curing concrete, *Road Res. Bull.*, No. 5 (1958), 49

The efficacy of using different membranes (plastic film, waterproof packing papers, waterproof hessian, bitumen cutback, bitumen emulsion, bitumen primer and wax emulsion) for curing concrete has been studied. The results indicate that the solid membranes are generally superior to the liquid membranes. Plastic film gives the best results and its use in arid regions will effect economy in the cost of concrete curing.

81. SANKARAN, K. S.: Gap graded concrete for pavement construction, *J. Indian Roads Congr.*, **23** (1958), 293

A method of concrete mix design for use in areas where the available sands are of poor grade or imported sands are too expensive is described. The design of concrete mixes using four typical sands of poor grade on the gap graded principle, wherein the gradation of coarse aggregate is adjusted so as to avoid particle interference, has been investigated. The study has shown that the concrete mixes compare very well with a standard continuous graded concrete mix in strength properties and the process is more economical.

82. SEHGAL, T. R. & HINGORANI, (Miss) D. V.: Sampling techniques in road traffic counts, *Road Res. Bull.*, No. 5 (1958), 73

A new method for estimating the average daily volume of traffic moving over a particular highway during the year under urban mixed traffic conditions in India by the application of statistical sampling techniques, which would considerably reduce the traffic counting cost, is described.

83. SUBBARAJU, BH. & GOKHALE, Y. C.: An investigation of a concrete pavement failure, *J. Indian Roads Congr.*, **23** (1958), 247

The probable reasons for the early development of cracking of slabs of cement concrete pavement have been studied and attributed to the excessive differential swelling and shrinkage properties of the particular subgrade soil. An attempt has been made to evaluate the induced stresses based on theoretical considerations and to estimate the probable crack expectancy period based on flexural strength values obtained from beams cut out from the road slabs. Certain precautionary and remedial measures have been suggested for concrete pavements.

84. SUBBARAJU, BH. & NANDA, R. L.: Assessment of riding qualities of some of the roads in India, *Road Res. Bull.*, No. 5 (1958), 3

A method for measuring the unevenness of highway pavements by means of a bump integrator is described. The method has been used for the assessment of riding qualities of some of the roads.

85. SWAMINATHAN, C. G. & ARUMUGA SWAMY, S.: Investigation of failures of a bituminous road, *J. Indian Roads Congr.*, **23** (1958), 435

The results of an investigation on the causes of failures of a bituminous road are discussed. Causes of the failures are grouped into three categories, viz. those arising from an unsatisfactory foundation or inadequate thickness of pavement, those due to failures of the base or wearing aided by the weathering of the binder and those due to water logging.

E CHEMISTRY 54

E : 2 *Physical Chemistry* 541.1

86. GURU MOORTI, V. R. & GHARPUREY, M. K.: Comparative study of the effects of silver precoats on the texture of zinc and cadmium films condensed from vapour *in vacuo*, *Optik, Stuttgart*, **15** (1958), 481

The texture of zinc and cadmium films condensed *in vacuo* at low vapour beam flux densities on to plastic substrates having silver pre-coats (average thickness, $\sim 10^{-3}$ to 10^{-1} A.) has been examined with an electron microscope. It is concluded that each silver crystallite in the pre-coat can nucleate zinc or cadmium equally well. The rate of deposition of the silver pre-coat does not appreciably influence the zinc and cadmium film textures.

87. GURU MOORTI, V. R. & GHARPUREY, M. K.: The texture of zinc and cadmium films deposited on fresh cleavage faces of mica, *Canad. J. Phys.*, **36** (1958), 1319

Studies on the texture of zinc and cadmium films condensed from vapour *in vacuo* on the two sides of mica cleavage have revealed well-matched textures in the corresponding regions on the two sides. In those cases where the deposition is due to the Frenkel mechanism of homogeneous nucleation there is similarity in the gross features alone. On the other hand, when the condensation is due to the presence of ' active ' centres of nucleation on mica surface, there is generally a one-to-one correspondence between the crystallites on the two faces.

E : 2133 Phase Systems 541.1201

88. KUBER, M. V., KULKARNI, S. B. & BISWAS, A. B.: On the phase equilibria of *p, p'*-DDT in binary systems, *Z. phys. Chem. Neue Folge*, **17** (1958), 155

The phase equilibria of *p, p'*-DDT with gammexane (γ-HCH), stearic acid and thymol have been studied using a modified Thiele's apparatus and the thaw melt method. These binary systems form simple eutectic mixtures. The latent heats of fusion of *p, p'*-DDT and γ-HCH have been evaluated as 6·7 and 5·8 k.cal./mole respectively. It is concluded that *p, p'*-DDT forms an ideal system with γ-HCH, a regular system with thymol and a non-ideal system with stearic acid.

E : 218 Structure 541.6

89. AGGARWAL, P. S. & GOSWAMI, A.: Structures of bismuth oxides formed by heating bismuth film in air, *Z. Naturf.*, **13A** (1958), 885

Studies on the structures of bismuth oxides formed by heating bismuth film in air or partial *vacuo* have been carried out using a Finch type of electron diffraction camera. Two new forms of bismuth oxide (a_0= 5·65 and 7·02 A.) have been observed during the oxidation of bismuth films. The well-known tetragonal variety (a_0= 10·93 A. and c_0 = 5·65 A.) appears to be a superstructure form of oxide (I).

E : 98 *Polymerization* 542.92

90. MENON, C. C. & KAPUR, S. L.: Initiation of polymerization of methyl methacrylate in aqueous solution by hydrazine hydrate, *Curr. Sci.*, **27** (1958), 245

A preliminary investigation of the polymerization of methyl methacrylate in aqueous solution initiated by hydrazine hydrate has been carried out and the relationship between the rate of polymer formation and the monomer concentration and the rate of hydrazine disappearance in the monomer concentration have been investigated. Evidence is presented for the free radical nature of the polymerization.

E1917 *Radioactive Substances* 541.15

E1917 : 3e Apparatus 541.15 : 543

91. BHATTACHARYYA, P. K.: A modified procedure for the oxidation of radiocarbon compounds, *J. sci. industr. Res.*, **17B** (1958), 467

A simple apparatus for carrying out oxidations of radioactive organic samples for radioactivity determinations is described in which the traces of sulphur trioxide in the gases produced as a result of oxidation of the samples are removed by bubbling the gases through a mixture of sulphuric acid and dichromate and the carbon dioxide efficiently absorbed in a small volume of alkali in a special type of bubbler.

E5 *Organic Chemistry* 547

E5 : 3053 X-ray Analysis 547 : 544.64

92. SHARMA, B. D. & BISWAS, A. B.: X-ray diffraction study of *n*-alkyl malonic acids, *Analyt. Chem.*, **30** (1958), 1356

n-Alkyl malonic acids, from methyl to octadecyl, have been synthesized and the X-ray powder diffraction data obtained are presented in a form applicable for analytical purposes. The results have been discussed with reference to those of the *n*-fatty acids and their derivatives. Difficulties that may arise in the identification of these compounds from their long spacings have been indicated.

E5 : 4 Synthesis 547.1

93. ACHARYA, R. V., MATHUR, M. S., SURYANARAYANA, B., TILAK, B. D. & VENKITESWARAN, M. R.: Quinone Series: Part XIII — Synthesis of naphthofurano-pyrrocolinequinones and mono- and dipyrrocolinequinones, *J. sci. industr. Res.*, **17B** (1958), 483

Some unsymmetrical substituted benzo-dipyrrocolinequinones have been obtained by the interaction of 5-carbethoxy-7 : 8-dichlorobenzo-(1 : 2-b)-pyrrocoline-6: 9-quinone and pyridine with acetylacetone and acetoacetanilide, and their structure confirmed by unambiguous syntheses, conversion to known products and by their colour reactions in sulphuric acid.

Furano-pyrrocolinequinones have also been obtained by the interaction of 5-carbethoxy-7: 8-dichlorobenzo-(1: 2-b)-pyrrocoline-6: 9-quinone with β-naphthol, α-naphthol and 2-hydroxy-3-naphthanilide.

With a view to synthesizing substantive vat dyes of the type 2: 3-phthaloylpyrrocolines and their aza derivatives, a series of 2: 3-phthaloylpyrrocoline-1-carboxyarylides has been synthesized by the interaction of 2: 3-dichloro-1: 4-naphthoquinone and terephthaloyl-*bis*-acetarylide.

94. Amin, J. H., Razden, R. K. & Bhattacharyya, S. C.: Experiments in the jasmone series: Part I — Synthesis of dihydrojasmone, *Perfum. essent. Oil Rec.*, **49** (1958), 502

A new and simple method has been developed for the synthesis of dihydrojasmone. The monosodio derivative of ethyl acetone dicarboxylate is condensed with amylbromide to yield 3-keto, 4-carbethoxy-ethylnonoate. The monosodio derivative of this material on further condensation with bromo acetone gives the product 2-aceto-methyl, 3-keto, 4-carbethoxy-ethylnonoate which on hydrolysis with alkali produces dihydrojasmone through the cyclization of the intermediate diketone.

95. Bose, J. L. & Dutta, N. L.: Isoflavones: Part II — A new synthesis of isoformononetin and daidzein, *J. sci. industr. Res.*, **17B** (1958), 266

Isoformononetin (7-methoxy-4′-hydroxy-isoflavone) and daidzein (7: 4′-dihydroxy-isoflavone) have been synthesized from 7-methoxy-4′-nitro- and 7-hydroxy-4′-nitroisoflavones respectively through the corresponding aminoisoflavones.

96. Ramanujam, S. & Seshadri, T. R.: Components of the bark of *Prunus puddum*: Part III — Synthesis of padmakastein and its derivatives, *Proc. Indian Acad. Sci.*, **48A** (1958), 175

The synthesis of padmakastein has been effected by the catalytic reduction of prunetin diacetate and subsequent deacetylation. Similarly, padmakastein dimethyl ether is obtained from prunetin dimethyl ether. The natural and the synthetic samples have been compared and found to be identical.

97. Sen, B. P., Chatterjee, A., Gupta, S. K. & Bhattacharyya, B. K.: Studies on hydrofluorene derivatives: Part I — Synthesis of 1: 2: 3: 4: 10: 11-hexahydrofluorene-2-one, *J. Indian chem. Soc.*, **35** (1958), 751

A new method of synthesis of 1: 2: 3: 4: 10: 11-hexahydrofluorene-2-one is described. The condensation of methyl 1-keto-2-indanylacetate with methyl succinate yields an acidic material which, after esterification, furnishes the condensation product which, on decarboxylation, followed by esterification and catalytic hydrogenation, furnishes the saturated di-ester. This, on Dieckmann cyclization, followed by acid treatment, yields the hexahydrofluorene-2-one.

E5-191 Organo-metallic Compounds 547.25

98. Kapoor, R. N. & Mehrotra, R. C.: Organic compounds of zirconium: V — Studies of zirconium mandelates, *J. Amer. chem. Soc.*, **80** (1950), 3569

The formation and characteristics of zirconium mandelates have been investigated. The reaction of zirconyl chloride with mandelic acid in aqueous solution yields mainly zirconium monomandelate which dissolves in one equivalent of alkali. The tetramandelate is formed only in the presence of higher concentrations of hydrochloric acid. The reaction between zirconium isopropoxide and mandelic acid in benzene shows that the carboxyl group is more reactive than the hydroxyl group in replacing isopropyl alcohol; the latter becomes active only when a sufficient concentration of carboxyl groups is not available. The following new compounds of zirconium have been isolated: $Zr(C_8H_6O_3)(OPr\text{-}iso)_2$, $Zr(C_8H_6O_3)(C_8H_7O_3)(OPr\text{-}iso)$, $Zr(C_8H_7O_3)_2(OPr\text{-}iso)_2$ and $Zr(C_8H_6O_3)(C_8H_7O_3)(OBu)$.

E9 *Biosubstances* 543.9

E92 Alkaloids 547.94

99. Talapatra, S. K. & Adityachaudhury, N.: Macralstonine, an alkaloid of the trunk bark of *Alstonia macrophylla* Wall, *Sci. & Cult.*, **24** (1958), 243

An alkaloid, macralstonine, m.p. 270-2° (decomp.) (molecular formula, $C_{44}H_{54}O_5N_4$), has been isolated from the trunk bark of *Alstonia macrophylla* Wall (N.O. *Apocynaceae*) (yield 0·06 per cent) and its properties studied by spectral analysis and its pharmacodynamic action. It is dextrorotatory in chloroform ($[\alpha]_D^{30} = +25{\cdot}8°$) but laevorotatory in pyridine ($[\alpha]_D^{30} = -22{\cdot}5°$). It is free from methylenedioxy group and contains one active hydrogen, one methoxyl and at least two C-methyl functions. N-Methyl data suggest the presence of three or four such groupings. It is more hypotensive than rauwolscine, the principal alkaloid of *R. canescens* Linn.

E92Z1 Peptides 547.964.4

100. Ingle, T. R.: Synthesis of tryptophan peptides, *J. sci. industr. Res.*, **17B** (1958), 492

The synthesis of a few tryptophan peptides is described. A convenient method for the preparation of L-tryptophan ethyl ester hydrochloride is also reported.

E94 Fats 547.915

101. Shenolikar, I. S. & Subbaram, M. R.: Iso-oleic acids: Part VI — Iso-oleic acids of beef liver and goat milk fats, *J. sci. industr. Res.*, **17C** (1958), 207

Identification of iso-oleic acids in beef liver and goat milk fats has been carried out using paper chromatography of the dicarboxylic acids obtained from the oxidation of iso-oleic acids. The dicarboxylic acids were separated into six spots, of which five were identified as acids ranging from suberic to dodecanedioic acids, the sixth spot (the one above dodecanedioic acid) being tridecanedioic acid. The presence of these six acids in the mixture of dicarboxylic acids shows qualitatively the presence of Δ^{-8}, Δ^{-9}, Δ^{-10}, Δ^{-11}, Δ^{-12}, and Δ^{-13} octadecenoic acids in the iso-oleic acid sample obtained from the above fats.

E94972 Essential Oils 547.913

102. Sharangapani, M. V., Siddappa, G. S. & Girdhari Lal: Studies on the extraction of citrus oils, *Essential Oils & Aromatic Chemicals — A Symposium* (Council of Scientific & Industrial Research, New Delhi), 1958, 81

Of the various methods studied for the cold extraction of oil from the fresh as well as dried peels of oranges, the one using a specially devised two-roller mill has been found to give satisfactory results as regards yield and quality. In this method, preliminary soaking of the fresh peels for about 4 hr in 0·10-0·25 per cent lime water and of dried peels for about 16 hr in 0·5-1·0 per cent calcium chloride solution increases the yield of oil. Mincing of the fresh as well as the dried orange peel prior to steam distillation facilitates the distillation of the oil within a short period of 4-5 hr as against 20-26 hr required in the case of the whole peel and helps in the recovery of oil of better quality. Prolonged storage of dried orange peels reduces the yield of oil.

103. Somasekar Rao, A., Kelkar, G. R. & Bhattacharyya, S. C.: Costunolide, a new sesquiterpene lactone from costus root oil, *Chem. & Ind.*, No. 42 (1958), 1359

A new sesquiterpene lactone, costunolide, having a ten-membered carbon ring system, has been isolated from costus root oil extracted under mild conditions which exclude any possibility of polymerization or denaturing. As a result of the investigations, two alternative structures have been suggested for the compound.

E94972:305 Analysis (Essential Oils) 547.913:545

104. Surve, (Miss) K. L., Chakravarti, K. K. & Bhattacharyya, S. C.: Spectrophotometric investigations of essential oils: Part II — Evaluation of lemongrass oil through ultraviolet spectrophotometry, *Perfum. essent. Oil Rec.*, **49** (1958), 624

A method, based on the characteristic absorption maximum of citral at 238 mμ, has been standardized for the evaluation of lemongrass oil through ultraviolet spectrophotometry. The method is superior to the conventional methods and enables a correct estimate of the actual citral content.

E95 Pigments 547.97

105. Pruthi, J. S. & Girdhari Lal: Carotenoids in passion fruit (*Passiflora edulis* Sims.) juice, *Food Res.*, **23** (1958), 505

The carotenoid pigments in passion fruit juice have been analysed employing the phase separation method and the Tswett column chromatographic technique with suitable modifications followed by a study of the absorption spectra of the isolated pigments, their colour reactions and mixed chromatograms. The following ranges of variation have been observed in the major groups: free xanthophylls, 10·3-21·5 per cent; xanthophyll esters, 11·1-34·6 per cent; and epiphasic non-saponifiables (mostly carotenes), 45·7-76·3 per cent of the total carotenoid pigment content and the following pigments have been reported: phytofluene, alpha-carotene, beta-carotene and zeta-carotene.

E971 Vitamin A 577.16

106. BALASUNDARAM, S., BAMJI, MAHTAB S., CAMA, H. R., SUNDARESAN, P. R. & VARMA, T. N. R.: Anhydro-vitamin A_2 and rehydro-vitamin A_2, *J. biol. Chem.*, **223** (1958), 827

Anhydro-vitamin A_2 and rehydro-vitamin A_2 (N) (a new compound) have been isolated from the liver oil of the fresh water fish *Wallago attu* and their spectroscopic characteristics and partition data have been studied. The spectroscopic properties and partition data of rehydro-vitamin A_2 obtained from livers of rats fed with pure anhydro-vitamin A_2 prepared from natural vitamin A_2 alcohol have also been studied. Chromatography of *Wallago attu* oil extracted in the cold showed that anhydro-vitamin A_2 and rehydro-vitamin A_2 (N) are not formed as a result of heat treatment during extraction, but are initially present in the liver oil.

Anhydro-vitamin A_2 could be prepared by treatment of vitamin A_2 alcohol with anhydrous ethanolic hydrogen chloride, but not with *p*-toluene sulphonic acid, thus confirming the presence of an ethoxy group in anhydro-vitamin A_2.

Anhydro-vitamin A_2 prepared *in vitro*, when fed to rats, is transformed into rehydro-vitamin A_2 in the livers, which is stored as an ester and alcohol in the liver.

E9G *Biochemistry* 577.1

107. GHOSH, S., ROY, D. & GUHA, B. C.: Arylamino-pyrimidines as growth-inhibitors of *Streptococcus faecalis* and *Lactobacillus arabinosus*, *Nature, Lond.*, **182** (1958), 187

In connection with studies of pyrimidines of possible chemotherapeutic value, several 2-arylamino-4-amino- and 2, 4-diarylamino-6-hydroxy pyrimidines have been synthesized and their effect on the growth of *S. faecalis* and *L. arabinosus* investigated. These compounds, particularly the diarylamino pyrimidines, have been found to be strong inhibitors of the growth of *S. faecalis* and *L. arabinosus*. However, these compounds, unlike the parent member of the series, 2, 4-diamino-6-hydroxy pyrimidine, and other 2, 4-diamino pyrimidines, have been found to be non-competitive inhibitors of folic acid in regard to the growth of *S. faecalis*.

108. ROY, D., GHOSH, S. & GUHA, B. C.: Inhibitory effects of some 2-arylguanidino-4-amino-6-oxy pyrimidines on the growth of *Streptococcus faecalis*, *Lactobacillus arabinosus* and *Escherichia coli*, *Naturwissenschaften*, **45** (1958), 392

2-Arylguanidino-4-amino-6-oxy pyrimidines having various substituents such as $-CH_3$, $-OCH_3$, $-NO_2$ and $-Cl$ in the *para* position of the benzene ring have been synthesized and their effect on the growth of *S. faecalis*, *L. arabinosus* and *E. coli* studied. All these compounds cause marked inhibition of growth of the micro-organisms. The electro-negative group ($-Cl$ or $-NO_2$) in the *para* position of the benzene ring attached to the guanidino bridge enhances the antibacterial activity more than the electro-positive group ($-OCH_3$ or $-CH_3$) in the same position. Further, these compounds are not competitively antagonized by folic acid in regard to the growth of *S. faecalis* and the growth-inhibitory effects on *S. faecalis* due to low concentration of these inhibitors can be significantly reversed by pyrimidine metabolites like uracil, cytosine, thymine and orotic acid in presence of folic acid.

109. WARAVDEKAR, SUSHEELA S. & RANADIVE, KAMAL J.: Biologic testing of 3, 4, 9, 10-dibenzpyrene, *J. nat. Cancer Inst.*, **21** (1958), 1151

3, 4, 9, 10-Dibenzpyrene has been tested for its carcinogenic activity. A ball-mill suspension of the compound in propylene glycol, administered subcutaneously in 16 mice of a hybrid strain, produced in the mice tumour of the subcutis in an average latent period of 74 days, thereby suggesting the potent carcinogenic activity of the compound. The carcinogenic activity of 3, 4, 9, 10-dibenzpyrene and two related polycyclic hydrocarbons has been discussed in relation to the K-region hypothesis.

E9G922 Proteins 547.96

110. NARASINGA RAO, M. S. & HIRA LAL: Metal protein interaction in buffer solutions: Part II — A polarographic study of the interaction of Zn^{II} and Cd^{II} with bovine serum albumin, *J. Amer. chem. Soc.*, **80** (1958), 3222

A polarographic study of the interaction of Zn^{II} and Cd^{II} with bovine albumin has been made. It has been observed that bovine albumin contains two sites, more reactive than imidazole, which combine with Zn^{II} in preference to Cd^{II}. The intrinsic constant for the interaction of Cd^{II} with bovine albumin, the two most reactive sites of which are covered by Zn^{II} ions, agrees well with the expected value for a 1:1 interaction with imidazole sites.

111. NARASINGA RAO, M. S. & HIRA LAL: Metal protein interactions in buffer solutions: Part III — Interaction of Cu^{II}, Zn^{II}, Cd^{II}, Co^{II} (and Ni^{II})

with native and modified bovine serum albumins, *J. Amer. chem. Soc.*, **80** (1958), 3226

Quantitative binding data for the interaction of metallic ions with bovine serum albumin have been interpreted in the light of electrophoretic data. The interaction of Cu^{II}, Zn^{II} and Cd^{II} with bovine albumin in the initial stages occurs through 2-3 compound sites involving an imidazole site and a neighbouring peptide N or peptide O. Peptide N appears to be involved in interactions with Cu^{II} and peptide O with Zn^{II} and Cd^{II}. Co^{II} and presumably Ni^{II} are, however, bound to free carboxyl sites of bovine albumin. A probable explanation of the distinctive feature of these interactions, as also the effect of acetylation and esterification of bovine albumin, has been put forth. Interactions involving Cu^{II}, Zn^{II} and Cd^{II} in the higher binding region are governed by a competition between imidazole and carboxyl sites to interact 1 : 1 with the metal ions and may be accompanied by configurational changes in the protein molecule.

E9G982 Enzymes 577.25

112. GHATAK, S., SAXENA, K. C. & AGARWALA, S. C.: Studies in the enzyme make-up of *Salmonella typhosa*: Part III — Catalase activity, *Enzymologia*, **19** (1958), 261

Five antigenic strains of *S. typhosa*, viz. *H*-901, *O*-901, *Ty*-2, *Vi* 1 and *Watson's V*, have been found to exhibit catalase activity; *Watson's V* exhibits maximum and *Vi* 1 minimum activity. The optimum *p*H for all the strains is 7·5. The hydrolysis of hydrogen peroxide by *Watson's V* is a linear function of time, 90 per cent of the activity being observed in the first 20 min. The type of medium employed has been found to have a pronounced effect on the catalase activity, papain-agar considerably reducing the activity of all the strains except *Watson's V*. The period of growth also has a significant effect on enzyme activity. Younger cells (of 16 hr growth) are much more active than cells of 72 hr growth. Dihydrostreptomycin, chloramphenicol, aureomycin, terramycin, achromycin, penicillin and neomycin inhibit the enzyme, the last two showing maximum inhibition, while hydroxylamine, cyanide and azide totally inhibit it.

F TECHNOLOGY 66

F191 *Metallurgy* 669

113. SANTOK SINGH, R., SOMAYAJULU, B. V. & NIJHAWAN, B. R.: Moulding characteristics of Oyaria sand, *J. sci. industr. Res.*, **17A** (1958), 458

The moulding characteristics of a sand sample from Oyaria in West Bengal have been studied. In the raw state, the sand shows optimum permeability and strength in the moisture range of 2·8-7·4 per cent. Maximum values for green permeability (230), green compressive strength (15 lb./sq. in.) and dry compressive strength (300 lb./sq. in.) are obtained at 4·8, 2·8 and 7·4 per cent moisture content respectively. The sand has, however, poor refractoriness (fusion point 1440°C.) and is not suitable for use in steel foundry practice, although it has been found to be useful for cast iron jobs.

114. SOMAYAJULU, B. V., GUPTE, P. K. & KRISHNAN, R. M.: Some observations on the recent developments in the CO_2 process, *Engng Times & Found. News*, **1** (1958), 39

Observations on recent developments in the CO_2 process for moulds and cores in foundries have been discussed and the mechanism of hardening has been outlined. Experimental data have been presented on the hardening characteristics of silicate-bonded sand mixtures, employing indigenous materials. The hardening characteristics obtained with moisture-free nitrogen and compressed air in place of CO_2 have also been reported.

F191 : 3053 X-ray Analysis 669 : 544.64

115. ALI, S. Z.: X-ray study of magnetite ore, *J. sci. industr. Res.*, **17B** (1958), 241

The results of X-ray examination of a rich magnetite ore from Daltonganj (Bihar), which contains about 30 per cent more Fe_2O_3 in the magnetic portion than expected from its FeO content, are presented. The presence of maghemite, γ-Fe_2O_3, is ruled out on the X-ray evidence. The excess of Fe_2O_3 is due mainly to the almost complete entrainment of the fine haematite particles in the stream of magnetite particles as they move in the magnetic field of the separator. Another interesting possibility contributing to the high Fe_2O_3 content in the ore is discussed and is shown to be operative.

F193 Alloys 669.018

116. RASTOGI, R. P. & RAMA VARMA, K. T.: Thermodynamic properties of binary alloys exhibiting miscibility in solid and liquid phases, *Proc. Indian Acad. Sci.*, **48A** (1958), 336

Heats of formation of liquid and solid nickel-manganese alloys have been computed from phase diagrams. The method is suitable for alloys exhibiting complete miscibility in solid and liquid phases and it can be used for testing the internal consistency of phase-equilibrium data. Heats of formation of solid and liquid alloys are found to be negative and similar in magnitude. It is concluded that the redistribution of valence electrons in the alloys is responsible for the negative heat of mixing.

F3 *Salts* 664.4

117. SESHADRI, K. & BUCH, (Late) S. D.: Elimination of algae in Sambhar Lake brine by chlorination, *J. sci. industr. Res.*, **17A** (1958), 455

Chlorination of Sambhar Lake brine or liquid bittern, either by passing chlorine gas or adding a solution of sodium hypochlorite or bleaching powder, has been found to be a convenient method for the elimination of algae present in them. An average dosage of 0·5 g. of available chlorine per litre of brine or bittern has been found to be effective in bleaching and destroying the algae and preventing their further growth. The treated liquor, on keeping, remains clear for an year after treatment.

F4414 *Glass & Ceramics* 666.3

118. GUHA, S. K. & SUDHIR SEN: Potentiometric and conductometric titration of minus two micron fraction of four Indian china clays, *Bull. cent. Glass Ceram. Res. Inst.*, **5** (1958), 109

Studies on the potentiometric and conductometric titrations of $<2\ \mu$ fraction of Indian china clays from Rajmahal, Cossimbazar, Simultala and Travancore have been carried out. From the potentiometric titrations of 0·5 and 1·0 per cent clay suspensions, the base-exchange capacity (bec) values at *p*H 8·5 have been determined and compared with the values obtained from conductometric titrations. The clays, with the exception of Cossimbazar clay, have been found to be kaolinitic. Colloidal suspension of kaolinite has been found to behave like a weak monobasic acid.

119. PRASAD, T. V., MURTHY, H. P. S., BHASKAR RAO, H. V. & RABINDAR SINGH: Thermogravimetric study of the oxidation of some natural graphites, *Industr. céram., Paris*, No. 499 (1958), 219

The susceptibility of certain Indian graphites to oxidation has been compared with that of crucible-grade Madagascar and Ceylon graphites, employing differential thermal analysis and thermogravimetric methods for studying the course and the rate of oxidation of these graphites. Oxidation of natural graphites is a reaction of first order. Patna graphite in the beneficiated form bears close similarity to Madagascar graphite.

120. SUDHIR SEN: Differential thermal analysis and thermogravimetric analysis studies on gypsum, *Bull. cent. Glass Ceram. Res. Inst.*, **5** (1958), 93

Differential thermal analysis (dta) and thermogravimetric analysis of gypsum from different sources have been carried out. The two-stage dehydration of the dihydrate, $CaSO_4.2H_2O \longrightarrow CaSO_4.\frac{1}{2}H_2O \longrightarrow$ soluble anhydride, the crystallographic transformation of soluble anhydride to the insoluble form and the presence of impurities like clay and magnesium-calcium carbonates have been studied by means of the dta curves. From the area of the exothermic peak the amount of hydrated calcium sulphate has been calculated. With different heating rates the peak temperatures decrease with lower rate of heating except for the exothermic peaks.

The dynamic method of thermogravimetric analysis has shown that the entire dehydration process is a continuous reaction and that gypsum can be dehydrated to a combined water content much lower than plaster of Paris even at 100°. In both the dynamic and the static methods of dehydration, a resistant state, with 0·25-1·0 per cent residual water, is reached towards the end of dehydration process which is overcome only at higher temperatures.

F5 *Organic Compounds* 661.7

F5 : 88 Catalytic Processes 661.7.097

121. BHATTACHARYYA, S. K. & GULATI, I. B.: Catalytic vapour-phase oxidation of xylenes, *Industr. Engng Chem.*, **50** (1958), 1719

A number of supported and unsupported single, binary and ternary catalysts containing vanadium, molybdenum, tin, silver, copper, cobalt, uranium and cerium have been tested for their comparative efficiency in catalysing vapour-phase oxidation of *o*-, *m*- and *p*-xylenes. Optimum operating conditions have been established for the active catalysts. The best catalyst has been found to be fused vanadium pentoxide; oxidation efficiency is most marked in the case of *o*-xylene, of which nearly 62 per cent can be converted to phthalic anhydride. Maleic anhydride is the main oxidation product of *m*- and *p*-xylenes. Other products include *m*- and *p*-tolualdehyde, *p*-toluic acid, isophthalic acid, terephthalic acid and quinones.

122. BHATTACHARYYA, S. K. & VENKATARAMAN, N.: Catalytic vapour-phase oxidation of benzene to maleic acid, *J. appl. Chem., Lond.*, **8** (1958), 728

The production of maleic acid by vapour-phase oxidation of benzene, using various catalyst combinations supported on different materials with addition of various amounts of cobalt oxide as promoter, has been investigated. Best yields of maleic acid (*c.* 58 per cent conversion of benzene) are obtained with V_2O_5-MoO_3-Co_2O_3 catalyst (38·9: 16·64: 2·8) supported on kieselguhr. The yield obtained with vanadium pentoxide catalyst alone is of the order of 25 per cent only, kieselguhr being the best among the supports studied. Among the binary catalysts, vanadium pentoxide-molybdenum trioxide effects maximum oxidation. Cobalt oxide is the best promoter, its optimum concentration being 5 per cent. The method of preparation of the metal oxides and of pretreatment of the support have been found to affect the results.

123. BHATTACHARYYA, S. K. & VENKATARAMAN, N.: Catalytic vapour-phase oxidation of crotonaldehyde to maleic acid, *J. appl. Chem., Lond.*, **8** (1958), 737

The oxidation of crotonaldehyde to maleic acid over various catalyst combinations has been studied and compared with the oxidation of benzene. About 76 per cent conversion of crotonaldehyde is obtained with a vanadium pentoxide-molybdenum oxide-kieselguhr catalyst. The effects of different preparations of catalyst and operating conditions on the percentage conversion are discussed. The presence of water in the crotonaldehyde is found to have little effect on the activity of the catalysts.

F55 *Fuel Technology* 662.6

124. MOHAN RAI: Sorel Cement as a binder for powder fuel wastes, *Curr. Sci.*, **27** (1958), 443

Experiments on the cementing properties of Sorel Cement have been carried out to test its use as a binder for briquetting fuel wastes. Briquettes made with 5 per cent magnesium oxide are found to be superior and able to withstand rough handling. The briquettes burn well without losing shape.

F551 Coal 662.66

125. CHAKRAVARTI, A. K., SARKAR, G. G. & LAHIRI, A.: A study on the removal of water from wet coal by natural drainage, *Indian Min. J.*, **6** (7) (1958), 1

Studies on the dewatering behaviour of the types of coal to be treated in central washeries in the Jharia and Bokaro coalfields have been carried out. The water retention in various washery products and the extent of its removal by cheap gravity means, and the possibilities of improving the dewatering behaviour of wet coal and reducing the moisture content of the drained products are discussed. By allowing the steam and slack sizes of coals to drain separately in suitable drainage bunkers, a considerable reduction in the surface moisture of the coal can be obtained, effecting a good saving in railway freight charges.

126. PAUL, R. & DAS GUPTA, A. K.: An experimental cross-draft producer, *J. sci. industr. Res.*, **17A** (1958), 357

The constructional features and performance characteristics of a cross-draft producer gas plant, designed and fabricated for use with coals of varying ranks, are described. The plant, which performs well as a small capacity gas producer, is provided with two tuyeres for blowing air in high velocity jets and a cast iron grate for intermittent ash discharge. The gas generating capacity of the producer can be varied from 500 to 3000 standard cubic feet (s.c.f.) of gas per hour. The average heating value of the gas generated is 130 B.t.u./cu. ft and the tar content of the gas varies from 2 to 4 grains/cu. ft.

The ash fusion characteristics of the fuels play an important part in maintaining the fuel bed in a suitable condition and the quality of gas depends on the velocity of air blast at the tuyeres.

The improvements in the design of such plants, which emerged as a result of studies with this producer, have been incorporated in the design of a 10,000 s.c.f./hr plant with four tuyeres.

F551:218 Coal Structure 662.66:541.6

127. CHAKRAVARTY, S. K., MAZUMDAR, B. K. & LAHIRI, A.: Disposition of hydrogen in coal structure, *Fuel, Lond.*, **37** (1958), 498

Oxidation studies with coal in air at 170°C. have shown that the non-aromatic part of coal structure can be oxidized leaving a COOH group at the point of linkage and the aromatic skeleton remains unaffected excepting for partial conversion of aromatic hydrogen to phenolic OH group and/or replacement by quinone groups. The aromatic hydrogen of coal can be calculated through this mechanism of oxidation incorporating the correction for the hydrogen replacement by the new quinone group and the residual non-aromatic hydrogen associated with COOH group in the oxidized residue. Aromatic hydrogen thus determined has been shown to increase progressively with increasing coalification. The aromaticity with respect to carbon, calculated from the values of aliphatic hydrogen assuming that CH_2 groups are predominant in non-aromatic part of the coal structure, has also been shown to be in good agreement with those obtained from chemical and statistical approaches.

128. MAZUMDAR, B. K. & LAHIRI, A.: Dimensions of side chains in coal structure, *Fuel, Lond.*, **37** (1958), 495

Studies on the oxidation of coal at 170°C. for 1000 hr and the gain in weight with subsequent changes in COOH-oxygen content have shown that in general the 'disordered' carbon around the periphery of the structural units in coal is present in either aliphatic or alicyclic networks and not in combinations of both. The average dimension of the side chains, if aliphatic, cannot be less than that of a 4-carbon system and if alicyclic, a 7-carbon system.

F551 : B2817 Coal Sampling 662.66 : 519.28

129. BOSE, R. N.: Statistical study of the heterogeneity of coal from the point of sampling, *Indian Min. J.*, **6** (8) (1958), 1

A simplified method has been devised to calculate the variance of ash between particles within a sample for a closely ranged size from the the results of the float and sink test on a coal. The sampling behaviour of a coal could be predicted from the variance between particles as calculated from float and sink data only if the degree of mixing of particles in the bulk could be measured. However, on the assumption of thorough mixing of particles, certain factors which contribute to the weight of a coal sample have been analysed.

130. CHAKRABORTY, P., TARAFDAR, T. C., GHOSAL, A. & DAS GUPTA, N. N.: Errors in the sampling of coke, *J. sci. industr. Res.*, **17B** (1958), 408

A new sampling procedure has been developed for the preparation of a laboratory sample of coke based on a statistical consideration of the magnitude of errors occurring at different stages of size and weight reduction of the original sample to the laboratory sample and its analysis. The results of experiments carried out with different coke samples suggest that with this procedure maximum error is introduced mostly at the third and the final stages of reduction, but the magnitudes of error at all stages are much smaller than those obtained while preparing a sample of coal for analysis. The new method may, therefore, be accepted as a standard procedure for coke sampling.

131. GHOSAL, A.: Errors in preparing a coal sample for analysis, *FRI News*, **8** (1958), 6

Statistical investigations on the steam and slack or rubble coals have suggested methods to bring down the large errors due to reduction from a gross sample to a laboratory sample to a minimum.

132. GHOSAL, A.: Theory of coal sampling, *J. sci. industr. Res.*, **17B** (1958), 301

A statistical study has been made of the theory of coal sampling with special reference to the problem of drawing of the samples from the source material in such a manner that the samples are representative of the source material with respect to ash content.

The choice of the proper weight for the gross sample is determined with reference to the estimated value of the variance. Of the two methods employed for calculating the variance, viz. the one based on a derived formula for predicting the sampling behaviour of coal from its float and sink data and the other based directly on samples drawn from the source, the latter has been found to be more rational.

F56 *Drugs* 615.45

F56 : 3051 Colorimetric Analysis 615.45: 545.81

133. ROY, A. C.: Estimation of estrogen and its derivatives in pharmaceutical preparations, *Indian J. Pharm.*, **20** (1958), 321

A suitable method for the estimation of estrogen and its derivatives in pharmaceutical preparations has been developed, based on the observation that mercuric nitrate in presence of nitrous acid gives a yellow colour with estrogen in alcoholic solution, the colour obeying Beer's law at 420 mμ.

F56 : 34 Quantitative Analysis 615.45 : 545

134. BOSE, P. C., SEN, T. & ROY, G. K.: Estimation of *p*-aminosalicylic acid and isoniazid in mixtures, *Indian J. Pharm.*, **20** (1958), 324

Several methods have been tried for the estimation of *p*-aminosalicylic acid (PAS) and isoniazid (INH) when present in a mixture in different preparations and the successful methods of analysis have been described, the samples analysed being (i) PAS (sodium salt) + INH, (ii) PAS + INH and (iii) PAS (calcium salt) + INH.

F58 *Dyes* 667.62

135. TILAK, B. D., UNNI, M. K. & VENKATARAMAN, K.: Anthraquinone and anthrone series: XXII — 3: 4: 9: 10-Dibenzopyrene and pentaphene from Indanthrene Scarlet 4G and Mayvat Brilliant Red AF, *Tetrahedron*, **3** (1958), 62

Mayvat Brilliant Red AF has been identified as a halogenated derivative of 3: 4: 9: 10-dibenzopyrene-5: 8-quinone (II), the latter being obtained by dehalogenation of Mayvat Brilliant Red AF or Indanthrene Scarlet 4G with Raney nickel, aqueous sodium hydroxide and hydrogen. Reduction of (II) with aluminium tricyclohexoxide gives 3: 4: 9: 10-dibenzopyrene (I), which is a potent carcinogen. Oxidation of 3: 4: 9: 10-dibenzopyrene-5: 8-quinone with chromic acid in glacial acetic acid gives pentaphene-5: 14: 8: 13-diquinone (V). Reduction of (V) with aluminium tricyclohexoxide yields pentaphene (VI). Condensation of (V) with hydrazine gives 1: 2-diaza-3: 4: 9: 10-dibenzopyrene-5: 8-quinone (VII), reduction of which with aluminium tricyclohexoxide gives 1: 2-diaza-3: 4: 9: 10-dibenzopyrene (VIII).

F84 *Synthetic Polymers* 678.7

136. GUNDIAH, S. & KAPUR, S. L.: Critical concentration effects in dilute solution viscosities of polymers, *J. sci. industr. Res.*, **17B** (1958), 330

The possible correlation between the critical concentrations obtained from direct viscosity-concentration plots for the polymers and by the viscosity behaviour of the tertiary system polymer A-polymer B-solvent S is discussed.

137. GUNDIAH, S. & KAPUR, S. L.: Precision viscometry of polyvinyl acetate in toluene, *J. Polym. Sci.*, **31** (1958), 202

Studies on solutions of linear polyvinyl acetate in toluene have shown that adsorption of the polymer molecules on the capillary walls of the viscometer alone cannot quantitatively account for the observed anomalous behaviour at very dilute concentrations.

F94 *Oils & Fats* 665.1

138. SUBRAHMANYAM, V. V. R. & ACHAYA, K. T.: Crystallization of Indian beef tallow fatty acids from aqueous ethanols, *J. Amer. Oil Chem. Soc.*, **35** (1958), 467

Studies on the crystallization of Indian beef tallow fatty acids (total saturated acid content, 64·3 per cent by weight) from six dilutions of ethanol (95-70 per cent) at five temperatures (20° to −12·5°C.) and at six solvent/acid ratios (2·5-20) have been carried out. Optimum conditions require 85 per cent ethanol at −12·5°C. at a solvent to acid ratio of 10. The comparatively saturated character of Indian beef tallows and the use of ethanol cause a departure from the Emersol process operating conditions using methanol, designed for American tallows. Considerations bearing on commercial application have been discussed.

F9495 *Drying Oils* 665.34

139. MENON, M. C., SHARMA, P. G. & AGGARWAL, J. S.: Coating compositions from modified kamala seed oil, *J. sci. industr. Res.*, **17A** (1958), 279

The suitability of kamala seed oil, modified by alcoholysis with monohydric alcohols, for the preparation of coating compositions has been investigated. The modified oil gave varnishes which were slightly inferior in hardness, drying and other characteristics to those prepared from tung oil.

FJ3 *Food Technology* 664

140. ANAND, J. C., SOUMITHRI, T. C. & JOHAR, D. S.: Effectiveness of some chemical food preservatives in controlling fungal spoilage in mango squash, *Food Sci.*, **7** (1958), 319

The effectiveness of different antifungal substances in inhibiting the growth of osmophilic yeast and *Aspergillus niger* in mango squash has been studied. Sodium propionate and sodium diacetate are not effective in controlling fungal spoilage in mango squash. Sulphur dioxide at 350 p.p.m. level controls the growth of yeast and mould efficiently while sodium benzoate does not inhibit mould growth even at 1000 p.p.m. level. A combination of 300 p.p.m. of sulphur dioxide with 200 p.p.m. of sodium benzoate helps to retain colour and taste. Use of 300 p.p.m. of sulphur dioxide and 250 p.p.m. of sorbic acid or 200 p.p.m. of sulphur dioxide and 500 p.p.m. of sorbic acid helps better retention of taste than 350 p.p.m. of sulphur dioxide used alone.

141. BAINS, G. S., KAPUR, N. S. & BHATIA, D. S.: Colorimetric determination of micro quantities of vanillin, *J. sci. industr. Res.*, **17B** (1958), 462

A colorimetric method is described for the quantitative determination of microgramme quantities of vanillin based on its reaction with excess of thiobarbituric acid in aqueous medium containing specified amounts of hydrochloric acid or phosphoric acid. The coloured complex shows a single absorption maximum at 432-434 mμ and the colour intensity of the complex obeys Beer's law at this wavelength when prescribed amounts of vanillin are reacted with thiobarbituric acid. The interference of sugars in the reaction and the application of the method to processed foodstuffs containing vanillin are discussed.

142. BHATIA, B. S., KAPUR, N. S. & SIDDAPPA, G. S.: Browning in some preserved fruit products, *Food Sci.*, **7** (1958), 251

Studies on browning in preserved fruit products have shown that addition of sulphur dioxide results in less browning than addition of sodium benzoate or pasteurization. Addition of citric acid, lime juice, sugar or ascorbic acid, on the other hand, increases browning. There is less browning in segments canned after lyepeeling; neutralization of acid does not play any part in this.

143. DAS, K. & BOSE, A. N.: Effect of salting on chemical composition and texture of green-mango slices, *J. Instn Chem. (India)*, **30** (1958), 197

The effect of salting on the chemical composition and texture of green-mango slices has been studied. Equilibrium in salt uptake is reached in 7-8 weeks and with the progress of salting the total acid content decreases by more than 50 per cent, while the lactic acid produced increases with storage. The lactic acid formed improves the flavour but softens the texture of the product. Calcium chloride (1 per cent) is found to harden the texture. Salted slices having weak texture are improved considerably in strength on treatment with sodium chloride containing calcium chloride.

144. JAIN, N. L., BHATIA, B. S. & GIRDHARI LAL: Studies on the preparation of apple preserve, *Indian J. Hort.*, **15** (1958), 30

A method for the preparation of apple preserve from the *Amari* variety has been standardized. The fruit is peeled with stainless steel knives, kept in a solution containing 2 per cent common salt and 0·05 per cent potassium metabisulphite, washed free of salt and steeped in a solution containing 3 per cent calcium lactate (or 1 per cent calcium chloride) and 0·1 per cent potassium metabisulphite overnight, washed and blanched for 10-15 min. in boiling water, followed by rinsing in tap water. It is then pricked and added to a sugar syrup of 25°Brix which is raised to 50°Brix over a period of 5-6 days. Citric acid (0·05 per cent) is then added and the Brix of syrup raised to 70-72°. The preserve is stored for 4-5 days in this syrup raising the Brix to 70-72° if necessary. It is then packed in hermetically sealed tin containers after adding boiling hot syrup. Addition of 200 p.p.m. sodium benzoate to the syrup before packing is recommended.

145. KAPUR, N. S., BHATIA, B. S., BHATIA, D. S. & GIRDHARI LAL: Studies on the non-enzymatic browning of food products: Sugar-organic acid model systems, *Food Sci.*, **7** (1958), 181

Studies on browning in model systems consisting of four sugars (glucose, galactose, fructose and sucrose) and ten organic acids (acetic, propionic, oxalic, succinic, malonic, malic, tartaric, citric, lactic and pyruvic) in pairs of one sugar and one acid have been carried out at 37°C. Maximum browning is observed in the case of fructose and minimum in the case of glucose. Oxalic, malonic, malic, tartaric, citric and pyruvic acids make significant contribution to browning. Oxalic and pyruvic acids cause maximum browning with fructose and sucrose, and accelerate their browning.

146. LEWIS, Y. S. & JOHAR, D. S.: Control of fermentation in settling tanks of sago factories, *Food Sci.*, **7** (1958), 285

Experiments on the control of excessive microbial growth in tapioca starch slurries for periods of 24-72 hr have shown that *Oidium*, *Saccharomyces*, *Lactobacillus* and *Bacillus* are the most commonly found genera of organisms, and 50-100 p.p.m. of sulphur dioxide either as gas or as potassium metabisulphate with hydrochloric acid added after the first 12-24 hr of storage are most effective in suppressing excessive microbial growth for 48-72 hr. Addition of another dosage of 50 p.p.m. of sulphur dioxide after 48 hr ensures the 72-hr non-spoilage period.

147. PRUTHI, J. S.: Flavour restoration in Valencia orange concentrate with orange oil and juice, *Indian Food Pack.*, **12** (12) (1958), 7

Experiments on the restoration of flavour of Valencia orange concentrates by (i) the 'cutting back' of five-fold concentrate with fresh juice and (ii) the addition of orange oil have indicated that in the case of concentrates having an oil content of 0·05 per cent and above, there is no significant difference between concentrates cut back with juice or water and those having added orange oil. In the case of concentrates containing less than 0·05 per cent oil, it is preferable to cut back with fresh juice. The restoration of flavour in orange juice concentrate is hence found to depend largely on its initial oil content which in turn depends upon the method of extraction of the juice.

148. PRUTHI, J. S., SRIVASTAVA, H. C. & GIRDHARI LAL: Microbiological spoilage in purple passion fruit (*Passiflora edulis* Sims.) during storage, *J. sci. industr. Res.*, **17C** (1958), 129

The nature of microbiological spoilage in purple passion fruit (*Passiflora edulis* Sims.) during refrigerated storage and its control and prevention have been investigated. The fungi responsible for the spoilage are: *P. expansum*, *A. niger*, *F. oxysporum* and *R. nigricans*. Packaging and storage of the fruit in polyethylene bags and wooden crates treated with 5 per cent Lysol solution have been found to prevent its spoilage.

149. Sawant, P. L., Andrabi, M. H., Magar, N. G., Pruthi, J. S. & Girdhari Lal: Nutritive value of canned fruits, *Indian Food Pack.*, **12** (10) (1958), 11

The effect of storage time and storage temperatures on the nutritive value of canned Coorg and *Sathgudi* oranges and canned bananas has been studied. Retention of vitamin C in canned Coorg and *Sathgudi* oranges and bananas is fairly good. Stability of the B-group vitamins and carotenes in the canned fruits is fair during storage. Acidity and inversion of sugar increase during storage. Iron and tin contents also increase during storage, especially at higher storage temperatures. Accumulation of tin is more in solids and of iron in the syrup. Phosphorus and calcium contents are practically constant throughout the storage period.

FJ3 : 3 Analysis 664 : 543.9

150. Dwarakanath, C. T., Ramachandra Rao, T. N. & Johar, D. S.: Chemical analysis of some varieties of Indian pepper (*Piper nigrum* L.), *Food Sci.*, **7** (1958), 285

Eleven varieties of Indian pepper, viz. *Kottandan*, *Kumbhakodi*, *Kuthiravally*, *Perumkodi*, *Karuvilanchi*, *Chumula*, *Uthirankotta*, *Karivally*, *Balankotta*, *Tulakodi* and *Kalluvally*, have been analysed. *Uthirankotta* and *Balankotta* do not conform to specified standards in regard to alcohol extract and ether extract values. *Kottandan*, *Kumbhakodi* and *Kuthiravally* have the highest percentage of crude piperine.

FM97 *Leather Technology* 675

151. Nayudamma, Y. & Jayaraman, K. S.: Studies on shrinkage phenomenon: Part III — Formaldehyde combination tannages, *Bull. cent. Leath. Res. Inst.*, **5** (1958), 91

Interpretations in regard to the mechanism of formaldehyde combination retannages made earlier on the basis of shrinkage temperature data have been confirmed by quantitative studies in regard to the fixation of formaldehyde in combination tannages.

152. Nayudamma, Y., Subbalakshmi, D. V., Chandrasekharan, K. & Ramanathan, N.: Studies on shrinkage phenomenon: Part IV — Area shrinkage, *Bull. cent. Leath. Res. Inst.*, **5** (1958), 173

A method using a planimeter has been worked out for the measurement of the area shrinkage (error, 3 per cent). It has been observed that the shrinkage varies from specimen to specimen, depending upon the location of the specimen in the hide or skin and also upon the pretreatments given to it. All tannages decrease area shrinkage of pelt to varying degrees. The ability to resist area shrinkage is enhanced when stable cross-links are formed. In combination tannages, the combined effects of the tanning agents are reflected in the area shrinkage values. The first tannage also has an important influence. Recovery of shrunken area does not appear to be dependent on shrinkage temperature, area shrinkage, cross-links formed or tannin fixed.

153. Ranganathan, S., Bose, S. M. & Nayudamma, Y.: Interaction of collagen with certain phenols-hexamethylene tetramine complexes, *Bull. cent. Leath. Res. Inst.*, **5** (1958), 131

Complexes of resorcinol, catechol and phenol with hexamethylene tetramine have been prepared and their interaction with collagen studied. The tanning effect of resorcinol-hexamethylene tetramine complex is found to be due to its cleavage to resorcinol, formaldehyde and ammonia and the subsequent linking of resorcinol and formaldehyde with the primary amino groups of collagen involving the formation of Mannich linkages. The reaction takes place at almost all *p*H levels, mostly from 3 to 8, at which polymerization is least.

G BIOLOGY 57

G21 *Microbiology* 576.8

154. Bhaskaran, K.: Genetic recombination in *Vibrio cholerae*, *J. gen. Microbiol.*, **19** (1958), 71

Certain pairs of genetically marked strains of *Vibrio cholerae*, when grown together and plated under selective conditions, have been found to give rise to greater number of colonies than either strain plated alone; in the case of other pairs in which this phenomenon does not occur, a large number of presumptive recombinants are obtained when one of the strains is made lysogenic with a particular phage. Although the small number of markers makes it impossible to do mapping studies, the evidence is strongly suggestive of recombination, probably phage-mediated transduction.

155. SINGH, B. N., MATHEW, S. & NITYA ANAND: The role of *Aerobacter* sp., *Escherichia coli* and certain amino acids in the excystment of *Schizopyrenus russelli*, *J. gen. Microbiol.*, **19** (1958), 104

Aqueous extracts of *Aerobacter* sp. and *Escherichia coli* have been found to cause excystment of viable sterile cysts of *Schizopyrenus russelli*, the factors causing excystment being thermostable. Paper partition chromatography of the aqueous extract of *Aerobacter* sp. showed that part of the excystment-inducing activity is due to the presence of amino acids.

Among the amino acids, sugars, purines, pyrimidines, nucleosides, nucleotides and organic phosphates tested for their ability to induce excystment, some amino acids and a few nucleotides are found to cause excystment. The effect of *p*H, concentration and time on excystment with amino acids has also been investigated.

I BOTANY 58

I786 *Gramineae* 582.542.1

156. BHARADWAJA, R. C.: On the grasses of Parasnath Hill (Bihar), *J. Indian bot. Soc.*, **37** (1958), 229

The various taxa of the Gramineae of Parasnath Hill (Bihar) have been analysed. The composition and distribution of the grass flora of the area are discussed and new grass species reported.

I8313 *Leguminosae* 582.736

I8313:2 Morphology 582.736

157. CHANDRA, V.: Studies in *Psoralea corylifolia* Linn., *J. sci. industr. Res.*, **17C** (1958), 148

Morphological features of the different parts of the plant and the anatomical characteristics of the root and stem of *Psoralea corylifolia* are described. Methods for the cultivation of the plant are also described.

K ZOOLOGY 59

K615 *Cestoda* 595.121

158. SINGHAL, DHARAM PARKASH: On a new species of cestode belonging to the genus *Hymenolepis* Weinland, 1858 from rats of Delhi State, *J. sci. industr. Res.*, **17C** (1958), 119

Hymenolepis timauria n.sp. is reported from house rats *Rattus rattus* Gray, 1837 from Delhi State. The worms measure 30-50 mm. in length and 0·324-0·473 mm. in width. Scolex is prominent, bearing well-developed suckers and a distinct rostellum. The rostellar hooks number 20-24, measuring 0·014-0·016 mm. in length, and are arranged in a single crown. Genital pore is unilateral. Cirrus sac is well past ventral longitudinal excretory vessel and testes are arranged in a transverse row behind the ovary in the posterior half of the segment. Ovary, consisting of 5-6 lobes, is transversely disposed in the anterior half of the segment. Vitelline gland is located between the ovary and the central testis; a part of it lies under the central testis as well. Eggs and onchospheres measure 0·040-0·050 and 0·25-0·031 mm. respectively in diameter. Embryonic hooks are quite distinct and measure 0·011 mm. in length.

K86 *Insecta* 595.7

159. MATHUR, R. N. & SEN-SARMA, P. K.: A new species of *Anacanthotermes* from South India (Insecta; Isoptera; Hodotermitidae), *Entomologist*, **91** (1958), 233

A new termite species *Anacanthotermes rugifrons* (Mathur and Sen-Sarma) is described, and a key to the *Anacanthotermes* species from Indian region is indicated.

160. SINGH, B.: Some more Indian Geometrid larvae (*Lepidoptera*), with a note on the identity of components of various groups of setae, *Indian For. Rec. Ent.*, **9** (1956), 131

The larval characteristics of 16 species belonging to 13 genera of the family Geometridae (*Lepidoptera*) [Geometrinae (4 genera, 4 species); Hemitheinae (7 genera, 8 species); Larentinae (1 genus, 1 species); and Sterrhinae (1 genus, 3 species)] are described. Keys to the genera and/or species are also provided. Hinton's criterion of length relationship among the components of various groups of setae is found to need modification. A simple criterion for determining the homology of the components of the various groups of setae of Geometrid larvae is provided.

L MEDICINE 61

L : 573 *Nutrition* 613.2

161. KURIEN, P. P., KRISHNAN, SIVARAMAN R., SWAMINATHAN, M., INDIRAMMA, K. & SUBRAHMANYAN, V.: The effect of partial or complete replacement of rice in poor vegetarian diet by *ragi* (*Eluesine coracana*) on the growth and composition of liver of rats, *Food Sci.*, **7** (1958), 322

The growth and the liver composition of livers of rats fed on rice diet partially or completely replaced by *ragi* have been studied. A replacement of 25 per cent or 50 per cent of rice by *ragi* markedly improves the growth-promoting value of the rice diet. There is no significant difference in the protein content of the livers of different groups of rats and the liver fat is slightly higher with diets containing 25, 50 or 100 per cent of *ragi*. *Ragi* is found to be a simple and cheap means of making up the calcium deficiency in poor rice diets.

162. MUKHERJEE, S., ACHAYA, K. T., DEUEL, H. J. & ALFIN-SLATER, R. B.: The effect of dietary fat on the fatty acid composition of cholesterol esters in rat liver, *J. Nutr.*, **65** (1958), 469

Studies on the effect of dietary fat on the fatty acid composition of cholesterol esters in rat liver have shown that with diets which maintain an animal and yield normal cholesterol levels, about 20 per cent of the cholesterol in the liver occurs esterified with polyunsaturated fatty acids. On lard diets, saturated cholesterol esters begin to accumulate, and on highly saturated diets, about 70 per cent of the liver cholesterol esters contain saturated fatty acids. On fat-free diets, essential fatty acids are depleted in the liver but can be restored with supplements of linoleate or cottonseed oil.

163. PRUTHI, J. S., GIRDHARI LAL, SWAMINATHAN, M. & SUBRAHMANYAN, V.: Effect of supplementation of poor vegetarian rice diet with passion fruit (*Passiflora edulis* Sims.) juice, squash and cane-sugar syrup on growth rate and calcium, phosphorus and nitrogen metabolism in albino rats, *Ann. Biochem.*, **18** (1958), 107

Studies on the effect of supplementation of rice diet with passion fruit juice, squash and cane-sugar syrup on the food intake, growth rate, and calcium, phosphorus and nitrogen metabolism in albino rats have revealed that the diet supplemented with pure juice produces maximum growth. The supplementation with juice has a beneficial effect on nitrogen, calcium and phosphorus assimilation. There is no significant difference with squash. The lower growth rate in the sugar and squash groups is attributed partially to the comparatively higher sugar content. No deterioration in general health is observed in any animal even after feeding continuously with the supplements over a period of ten months.

164. SUBRAHMANYAN, V., SREENIVASAMURTHY, V., KRISHNAMURTHY, K. & SWAMINATHAN, M.: The effect of different diets on the intestinal microflora of rats, *Ann. Biochem.*, **18** (1958), 117

The effect of feeding different diets on the intestinal microflora of rats has been investigated. A diet rich in milled rice produces a low count of coliforms, aerobes and anaerobes. Replacement of rice with tuber flour results in an increase in the anaerobes or total count. Replacement of rice with pulses results in an increase in all the types of organisms. Supplementation of the rice diet with milk causes an increase in all the groups of organisms, while addition of the same quantity of curd causes an increase in the aerobic and anaerobic counts only.

L : 63 *Pharmacology* 615.1

165. KAR, A. B., ROY, S. N. & DAS, R. P.: Effect of aldosterone monoacetate and desoxycorticosterone acetate on the testes of young rats, *Acta endocr., Copenhagen*, **29** (1958), 361

Studies on the effect of aldosterone monoacetate and desoxycorticosterone acetate on the testes of young rats have shown that aldosterone monoacetate arrests the development of testes as shown by low testes weight and cessation of spermatogenesis at the primary spermatocyte stage. The differentiation of Leydig cells is also inhibited but atrophic changes are absent in the interstitial elements. Total cholesterol content of the testes shows no alteration on absolute basis but the relative concentration is elevated. The seminal vesicles do not show any appreciable change in weight or histology.

Desoxycorticosterone acetate also causes some retardation of testicular development in similar rats as indicated by low weight of the testes and arrest of spermatogenesis at the spermatid stage. Leydig cell differentiation is slightly inhibited without any atrophic changes in the interstitial elements, thus indicating that aldosterone monoacetate is more active than desoxycorticosterone acetate. At the dosage used the former is about twice as potent as the latter.

166. KOHLI, J. D., BALWANI, J. H. & DE, N. N.: Pharmacological action of rauwolscine: Part II—

General pharmacology, *Arch. int. Pharmacodyn.*, **114** (1958), 32

Drug antagonism between rauwolscine and chemical regulators of body function, viz. adrenaline, acetylcholine and histamine, has been studied and it has been found that rauwolscine is a non-specific general spasmolytic drug. Rauwolscine does not antagonize muscle depressor effect of any of the three drugs. As a local anaesthetic rauwolscine is slightly weaker but in frog plexus it is only $\frac{1}{2}$-$\frac{1}{4}$ as potent as cocaine. Introduced intradermally, it causes local necrosis.

167. MUKHERJEE, S. K., DE, U. N. & MUKERJI, B.: Studies in experimental diabetes: Part VI — Effect of desiccated thyroid and corticotrophin and their combination with insulin on alloxan diabetes in albino rats, *Indian J. med. Res.*, **46** (1958), 403

Studies on the effect of administering desiccated thyroid and corticotrophin and their combination with insulin on alloxan diabetes in albino rats have been carried out. Prior injections of insulin, 1 and 2 units daily, for 7 and 14 days or of corticotrophin, 2 mg. daily, for 7 and 14 days do not exert any protective action against the diabetogenic action of alloxan in albino rats. Prior treatment with insulin, on the other hand, appears to render the animals more susceptible to the diabetogenic action of alloxan. Feeding of desiccated thyroid, 100 mg. daily, for 6 and 12 days prior to alloxan administration shows some protective action against the diabetogenic action of alloxan. Alloxan diabetic rats, treated with insulin (4 units daily) or with corticotrophin (1 mg. daily) or with insulin and corticotrophin combined together in the same dose, do not show any amelioration in their diabetic condition. Feeding of desiccated thyroid (10 mg. daily) for 8 weeks to alloxan diabetic rats causes recovery from diabetes in 1 out of 8 animals but combined treatment with insulin (4 units daily) and thyroid feeding (10 mg. daily) for 8 weeks causes recovery from diabetic condition in 8 out of 16 animals. It appears that combined insulin and thyroid treatment may cause complete recovery from alloxan diabetes in albino rats. The improvement may be due to the pancreatropic action of thyroid on cells assisted by the hypoglycemic action of insulin.

168. NAYUDU, S. G. & NATH, M. C.: Effect of acetoacetate on the adrenaline content of the adrenals of normal and scorbutic guinea-pigs, *J. sci. industr. Res.*, **17C** (1958), 172

The effect of stimulating the adrenal medulla on acetoacetate-induced diabetes has been examined. The size and adrenaline content of the adrenals increase in scorbutic guinea-pigs. Repeated daily injections of acetoacetate cause an increased secretion of adrenaline both in normal and scorbutic guinea-pigs. Single injection of acetoacetate, however, does not show any appreciable increase in the adrenaline content of the adrenals. The weights of adrenals are not affected by single or repeated injections of acetoacetate.

169. ROY, S. N. & KAR, A. B.: Ponderal and histologic changes in the adrenal cortex of castrated rats after treatment with tri-iodothyronine, *Indian J. med. Res.*, **46** (1958), 739

Studies on the effect of tri-iodothyronine (TIT) on the adrenal cortex of castrated rats have shown that TIT causes stimulation of the adrenal cortex as seen by an overall increase in weight and hypertrophy of the inner zones. Characteristic disposition and the increase in the number of lipid vacuoles have been observed in the histologic features of the cortex. Testosterone propionate was found to interfere with the action of TIT in similar rats and minimize the ponderal and histologic effects of the latter on the adrenal cortex.

170. ROY, S. N., ROY, S. K. & DE, N. N.: Effect of testosterone propionate on the thyroid of thiourea-treated rats, *Indian J. med. Res.*, **46** (1958), 396

The effect of testosterone propionate on the thyroid of thiourea-treated rats has been investigated. Factors such as duration of thiourea administration, stage of thyroid hyperplasia at which hormone therapy is instituted, the dose of testosterone and the state of adrenocortical activity as influenced by testoid probably determine the ultimate response of the thyroids of goitrogen rats to testosterone treatment.

171. ZAIDI, S. H. & SINGH, G. B.: Experimental peptic ulceration: Part III — Effect of anticholinergic drugs on histamine-induced ulceration, *Indian J. med. Res.*, **46** (1958), 411

Anticholinergic drugs oxyphenonium bromide, stropine sulphate, scopolamine methyl bromide, probanthine and esentil have been investigated for their anti-ulcer activity in guinea-pigs in which ulceration was produced with massive doses of histamine protected against its toxic effects by an antihistaminate, promethazine hydrochloride. Maximum protection from ulceration is effected by oxyphenonium bromide, the rest following in a descending order. Anticholinergic drugs used in the present investigations do not appear to cause an increase of mucous or consistently suppress the volume or free acidity of the gastric contents. There is, however, a marked inhibition of peptic activity. The degree of prevention of ulceration by anticholinergic drugs is related to the inhibition of peptic activity.

172. ZAIDI, S. H., SINGH, G. B. & KHANNA, N. M.: Experimental peptic ulceration: Part IV — Effect of mucous stimulants on histamine-induced ulceration, *Indian J. med. Res.*, **46** (1958), 732

The effect of mucous stimulants on experimental peptic ulceration produced by massive doses of histamine in guinea-pigs protected by antihistaminic promethazine hydrochloride has been investigated. Eugenol in small doses (0·5 per cent emulsion) lowers free acidity and peptic activity and gives significant mucous response which prevents ulceration. Studies with sodium, barium and calcium eugenates have indicated the liberation of eugenol and the last compound has been found to be the most active in the prevention of ulceration.

U GEOGRAPHY 91

U296 *Ionosphere* 515.510.535

173. ABHIRAMA REDDY, C., RAMACHANDRA RAO, B. & SRI RAMA RAO, M.: Magneto-ionic fading in pulsed radio waves reflected at vertical incidence from the ionosphere, *J. Brit. Instn Radio Engrs*, **18** (1958), 669

The results of studies on magneto-ionic fading in pulsed radio waves vertically reflected from the F_2 region of the ionosphere are presented. Phase paths of the two interfering magneto-ionic components are calculated on the basis of ray theory assuming a parabolic distribution of ionization in the F_2 region. The calculated frequencies of fading are found to agree fairly well with the observed values. A method of deducing the semi-thickness of the F_2 layer from the observed frequencies of fading is presented and results obtained by this method are discussed.

174. DATTA, S.: On the electron production rate in the F_2 region of the ionosphere, *Indian J. Phys.*, **32** (1958), 483

A method for computing the electron production rate in the F_2 region of the ionosphere is described. A column of unit cross-section of the F_2 region extending from its bottom to the height of its maximum electron density is divided into four columns of equal length and the mean production rate in each of the columns calculated using diurnal variation of the total number of electrons in each of the columns and the height variation of the attachment coefficient. The method leads to regular consistent values for the diurnal variation of the electron production rate with a single peak at about half an hour before noon and eliminates the anomalous results that are sometimes obtained when other methods of computation are employed.

175. RAMACHANDRA RAO, B. & BHAGIRATHA RAO, E.: Effect of enhanced solar activity on F_2 region drifts at Waltair, *J. sci. industr. Res., Suppl.*, **17A** (No. 12) (1958), 59

The results of harmonic analysis of drift data taken on a number of SWI days during the first one year of the IGY period have been analysed with a view to studying the effect of solar activity on F_2 drifts. Comparison of these results with those obtained on quiet days has revealed that the variation on the NS component is considerably affected on the SWI days on which prominent solar flares were reported. No significant effects were noticed on other days.

176. RAMACHANDRA RAO, B. & SATYANARAYANA MURTY, D.: A new continuous wave radio method for the study of ionospheric drifts, *J. sci. industr. Res., Suppl.*, **17A** (No. 12) (1958), 63

A simple method for measuring the ionospheric drifts using transmissions from distant broadcasting stations is described, and the method has been utilized for measuring drifts in the E and F_2 regions. Comparison of the results obtained by this method with those obtained by using the standard spaced receiver pulse method showed that this method gives reliable and consistent results. By choosing proper operating frequencies, it is shown that the method can be used for measuring drifts at different positions in the ionosphere by taking observations from the same receiving centre.

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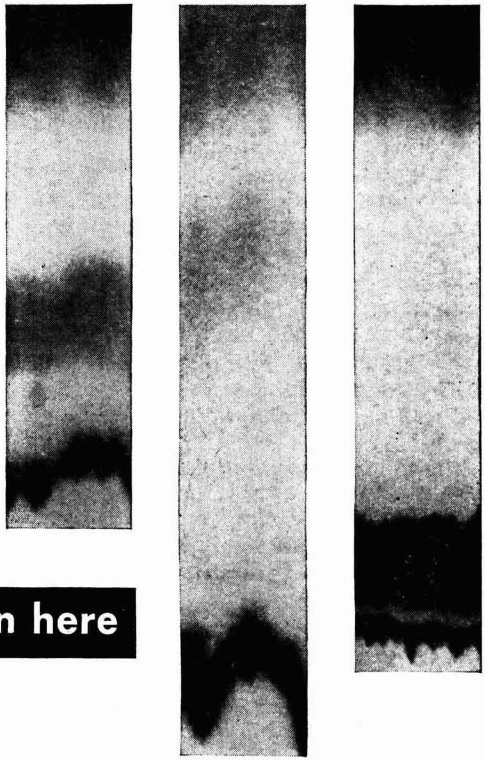

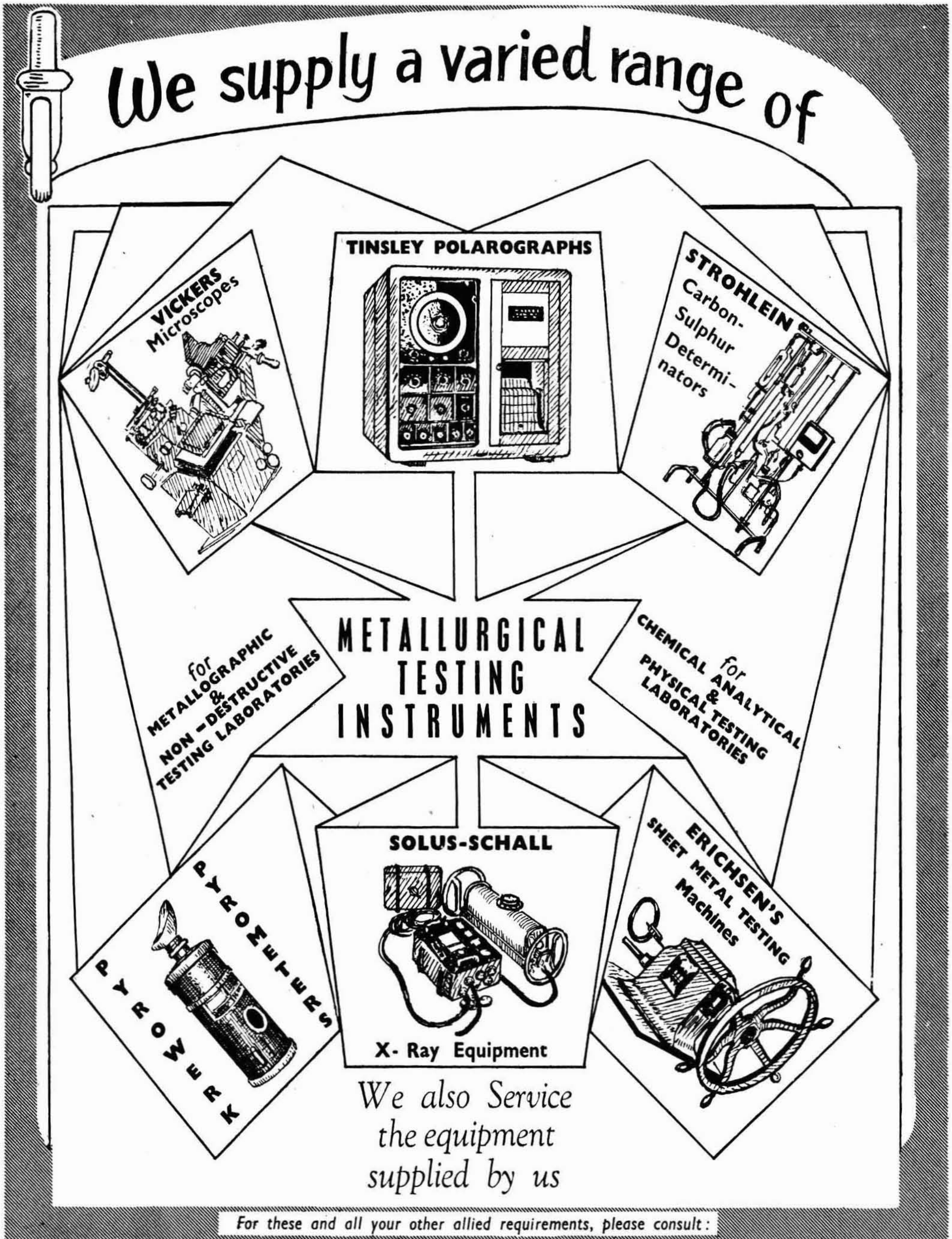

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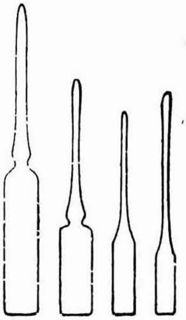

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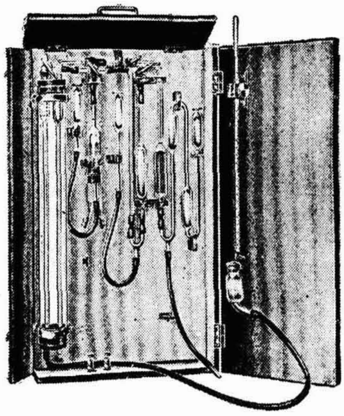

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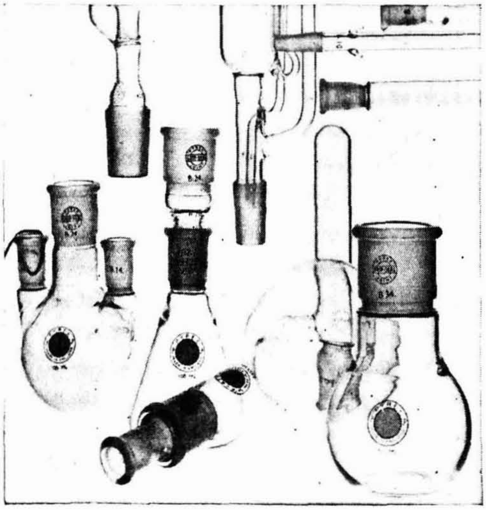


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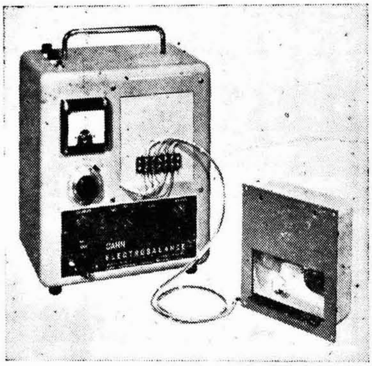
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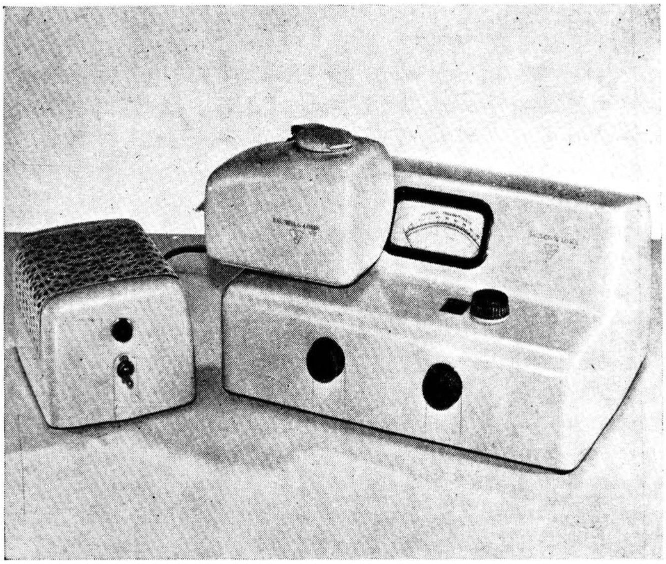

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