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The Future in Education

SIR RICHARD LIVINGSTONE'S presidential address to Section L (Educational Science) of the British Association at the recent Blackpool meeting is one which should receive attention from all who are interested in educational purposes and scope. His views concerning some of our fundamental ideas on education must either be accepted —in which case far-reaching changes of thought and practice are necessary—or they must be proved to be mistaken. For our part, we believe he has put his fingers upon weaknesses which must be remedied both from the material point of view of value for educational expenditure, and from the philosophical point of view which would have education fit the masses for the tasks—and possible struggles—which lie ahead.

Sir Richard described the three-fold function of man: to make a livelihood, to be a citizen and to be a man; and he asked whether, despite our achievements since the education Acts of 1870 onwards, through which the main lines of our primary, secondary, technical and university organization were laid down, we can now claim to be an educated nation. Does our system make men and citizens? If the majority of an electorate are incapable of benefiting from what are called humanistic studies, "we must either abandon democracy or resign ourselves to be governed by an electorate which can never know what a state should be. Ancient tradition and political instinct may preserve such a democracy from disaster, but not only will its stability be precarious, but its political and spiritual life will be poor. The bad film and the betting news will be its relaxation; the bad press its literature, passion, prejudice, the catchword and the slogan will be its masters".

If the education of children ceased at fourteen years of age in the past, it mattered perhaps less than it does now. Education for leisure would have little purpose if the working man lacked leisure. "Fifty years ago the employment of leisure was no problem for any but the well-to-do who mostly wasted it. To-day it is becoming a commonplace in education." At fourteen years of age a child has made a beginning in many subjects: he has received a training which enables him to use opportunity for learning more: but he knows nothing of the forces affecting his country which, as a voter, he will help to determine. Economic and political theories are outside his range; his knowledge of literature is small, his knowledge of science smaller.

Ordinarily, the answer to such criticisms is that the school-leaving age should be raised. But it is here that Sir Richard Livingstone's first challenge appears. He does not argue *against* raising that age, but he says plainly that it will not, in itself, solve our problems. He makes the telling point that education must be adjusted not only to the natural capacities of the pupil, but also to the stage of development his brain has reached. "At the age of 14 or 15 the mind cannot cope with, if it can conceive, the subjects which compose a liberal education and are vital to the citizen." When, therefore, the Hadow Report spoke of giving a "liberal and humane" education through the schools it proposed, it was using "one of those phrases sounding seductive, but untrue, into which all of us are at times betrayed. The thing is impossible because a humane and liberal education includes subjects which a fifteen-year-old is not sufficiently adult to grasp". In short, maturity

of mind is essential to humanistic studies for which full understanding demands experience of life.

What, then, is the solution? Sir Richard is emphatic that it does not lie in secondary education "about which this age is over-credulous. . . . We must keep our faith in it, but temper it with scepticism", since it is only one part of a great picture from which, to see it as a whole, we must stand back a little.

If the value of raising the school-leaving age is moral and economic rather than intellectual, and if secondary education is insufficient, where must we turn? One direction must be that of adult education. "In every point except the economic one, adult education has the advantage over secondary education. . . . It is given to students who desire it, who have the mental development to receive it, and have the experience of life to value and interpret it."

In this connexion it is inevitable that we should think of the Workers' Educational Association. Sir Richard Livingstone rightly emphasized the value of its work, but here, too, he rightly challenges complacency and indicates weaknesses. Our population is some 43,000,000. In 1935 there were 59,000 students in W.E.A. classes (at a cup-tie final there are twice that number!). The W.E.A. has therefore left untouched the vast mass of the population, although it has provided for their intelligentsia. Such studies as it has provided must continue, but for the ordinary man a different treatment is needed. Subjects must be brought into connexion with his outlook, his interests and his mind. To do this, Sir Richard sees that new methods must be sought, and he does not hesitate to say that "one of the reasons perhaps why so little progress has been made in adult education is that teachers have mostly been men with honours degrees who have brought to their work the methods and outlook of their own education".

There remain still the problems of post-primary education, and here Sir Richard's suggestions can be said to go back to the ideas adumbrated when the Education Act of 1918 was in preparation. Briefly, "the ideal plan might be for everyone to leave school at 15 and pass into a system where a part of the week was allotted to school, part to earning the living in some practical occupation, the proportions of each varying with the intellectual abilities of the pupil and the demands of the subjects he was studying". For our part we believe that such a system of part-time education would achieve far more than a system which merely raises the school-leaving age with the view of lengthening the period of full-time education. Like Sir Richard, we would not argue against raising the school-leaving age: but, whether that age be fourteen or fifteen or even more, we believe that an education such as Sir Richard has suggested will be best achieved if the pupil has some knowledge of and contact with the practical world. If education is a preparation for life, it cannot neglect the world in which we live. That world rests upon industrial and commercial foundations, and it is only when a pupil has had some contact with the realities found in practical occupations that he will appreciate the value and purpose of education. In Sir Richard's words, "theory will be illuminated by practice and practice by theory. At present the two are nearly always divorced. We lead a life of action without thought; or we think in a vacuum without contact with the realities and problems of the world. Neither form of isolation is satisfactory". What happens at present is that, on reaching the school-leaving age, the great mass of pupils are expelled abruptly from educational influence: and, without it, the real significance of democratic rights and duties is lost and the possibilities of a wide adult education almost hopelessly diminished.

A scheme of part-time education may, of course, be impossible for all pupils, but even those who follow the usual path to the university might avoid suffering from ignorance of life if a layer of practical experience could be imposed between school and university. The 'sandwich system' followed by engineers is an example.

Wisely, in our view, Sir Richard Livingstone did not attempt full and detailed programmes: that, as he said, would be a fitting task for the Board of Education's Consultative Committee. But, whatever the details may be, we believe he has made out a case for serious change, and his case must either be answered or accepted. His challenge to our present system cannot be denied unless the terrible implication of the following passage can also be disputed: "At present life is so arranged that most of us do our thinking in youth at an age when we are not best fitted for it, and having left the university think, systematically, no more. What wonder that middle life finds so many men unaware of recent progress in their own field, unapt for new experiments and ideas, deeply embedded in their rut, while progress waits impatiently for their death and the arrival of the next generation!"

Natural Selection and Evolutionary Progress*

By Dr. J. S. Huxley

Rate-Genes and Selection

THE results of selection at one period of the life-cycle may have repercussions on other periods and affect the species as a whole in unexpected ways. Perhaps the best example is that of intra-uterine selection in polytocous mammals, where rapidity of growth must be at a premium. This is likely to be transferred in whole or in part to post-natal life; intra-uterine selection may thus help to account for the progressive increase in size seen in so many mammalian lines during their evolution. At any rate, the converse seems to hold. One of the most characteristic features of man is a slowing down of general rate of development. Without it he could not in all probability have become fully human or biologically dominant. This condition could not have occurred until after man's ancestors ceased to have litters and began to bring forth a single young at a birth.

Haldane, in an interesting paper, discusses these and similar phenomena from the point of view of the time of action of the genes controlling them. A more comprehensive view, however, would include as still more important the genes' *rate* of action.

The concept of rate-genes provides a great simplification of the facts of recapitulation and anti-recapitulation. Whenever the rate of a process is correlated with time of onset and final equilibrium-level, a mutation causing an increase in rate will produce recapitulatory phenomena.

Conversely, a mutation causing a decrease in rate will have anti-recapitulatory effects. It will prolong the previous phase longer in ontogeny; it will not only slow the process down but also stop it at a lower level of completion, and it will remove certain previous adult characters and push them off the life-history. Many of the phenomena of so-called 'racial senescence' in ammonites may be due to phenomena of this type.

As de Beer has pointed out, when cænogenetic changes occur in the embryo or larva, the adult remaining unchanged, neither palæontology nor comparative anatomy would register any phylogenetic advance. But if now neoteny or fœtalization occurs, the old adult characters may be swept off the map and be replaced by characters of a quite novel type. This process he calls *clandestine evolution*. Garstang has suggested that it has operated on a large scale in the ancestry of vertebrates and of the gastropods.

* *Continued from p.* 573.

A clear-cut small-scale example comes from the snail *Cepea*. Its non-banded varieties are produced not because their genes cause the total absence of pigment, but because they slow down pigment-formation and delay its visible onset relatively to general growth, to such an extent that growth is completed before any pigment can be formed.

This is a comparatively unimportant effect; but when major processes are affected such as metamorphosis, sexual maturity, or general rate of growth or development, the results may be far-reaching. Pædogenesis, neoteny and human fœtalization are examples.

The existence of rate-factors has an important bearing upon the problem presented by apparently useless characters. For alterations in the rate of a process will often automatically produce a number of secondary and apparently irrelevant effects. Numerous examples of such 'correlated characters', as Darwin called them, are now known.

Results of Selection, Good and Bad

It is a common fallacy that natural selection must always be for the good of the species or of life in general. In actual fact we find that intra-specific selection frequently leads to results which are mainly or wholly useless to the species as a whole, including 'hypertelic' characters.

In other cases intra-specific selection may even lead to deleterious results. This is especially true with intra-sexual competition, between members of the same sex of the same species. We may, however, go further and proclaim with Haldane that intra-specific selection is on the whole a biological evil.

This conclusion is of far-reaching importance. It disposes of the notion, so assiduously rationalized by militarists and *laisser-faire* economists, that all man needs to do to achieve further progressive evolution is to adopt the most thoroughgoing competition: the more ruthless the competition, the more efficacious the selection, and accordingly the better the result. But we now realize that the results of selection are by no means necessarily 'good', from the point of view either of the species or of the progressive evolution of life. They may be neutral, they may be a dangerous balance of useful and harmful, or they may be definitely deleterious.

Evolutionary Progress

This question of evolutionary progress remains. It is not true that the use of the word *progress* is a mere anthropocentrism. There *has* been a trend during evolution which can rightly be called progressive and has led to a rise in the level of certain definable properties of organisms. The properties whose rise constitutes biological progress can be defined in the broadest terms as control over the environment and independence of it. More in detail, they consist in size and power, mechanical and chemical efficiency, increased capacity for self-regulation and a more stable internal environment, and more efficient avenues of knowledge and of methods for dealing with knowledge. One-sided progress is better called specialization.

As revealed in the succession of steps that led to new dominant forms, progress has taken diverse forms : at one stage, the combination of cells to form a multicellular individual, at another the evolution of a head ; later the development of lungs, still later of warm blood, and finally the enhancement of intelligence by speech.

So much for the fact of progress. What of its mechanism ? It will be clear that if natural selection can account for adaptation and for long-range trends of specialization, it can account for biological progress too ; for progressive changes have obviously given their owners advantages. There is no more need to postulate an *élan vital* or a guiding purpose to account for evolutionary progress than to account for any other feature of evolution.

One somewhat curious fact emerges from a survey of evolutionary progress. It could apparently have pursued no other course than that which it has historically followed. For example, the final step taken in evolutionary progress to date is that to conceptual thought. We see, however, that this could only have arisen in a monotocous mammal of terrestrial habit, but arboreal for most of its mammalian ancestry. All other known groups of animals are ruled out. Conceptual thought is not merely found exclusively in man : it could not have been evolved on earth except in man. Only along one single line is progress and its future possibility being continued—the line of man.

The Evolutionary Future

What of the future ? Man is not destined to break up into separate radiating lines. For the first time in evolution, a new major step in biological progress will produce but a single species. We can also set obvious limits to the extension of his range. Thus the main part of any large change in the biologically near future must be sought in the improvement of the brain.

In any case, one important point should be borne in mind. After most of the major progressive steps taken by life in the past, the progressive stock has found itself handicapped by characteristics developed in earlier phases, and has been forced to modify or abandon these to realize the full possibilities of the new phase.

Man's step to conscious thought is perhaps more radical in this respect than any other. By means of this new gift, man has discovered how to grow food instead of hunting it, and to substitute extraneous sources of power for that derived from his own muscles. For the satisfaction of a few instincts he has been able to substitute new and more complex satisfactions, in the realm of morality, pure intellect, æsthetics and creative activity.

The problem immediately poses itself whether man's muscular power and urges to hunting prowess may not often be a handicap to his new mode of control over environment, and whether some of his inherited impulses and his simpler irrational satisfactions may not stand in the way of higher values and fuller enjoyment.

Man seems generally anxious to discover some extraneous purpose to which humanity may conform. Some find such a purpose in evolution. The history of life, they say, manifests guidance on the part of some external power ; and the usual deduction is that we can safely trust that same power for further guidance in the future.

I believe this reasoning to be wholly false. Any purpose we find manifested in evolution is only an apparent purpose. If we wish to work towards a purpose for the future of man, we must formulate that purpose ourselves. Purposes in life are made, not found.

The future of man, if it is to be progress and not merely a standstill or a degeneration, must be guided by a deliberate purpose. This human purpose can only be formulated in terms of the new attributes achieved by life in becoming human. Human purpose and the progress based upon it must accordingly be formulated in terms of human values ; but it must also take account of human needs and limitations, whether these be of a biological order, such as our mode of reproduction, or of a human order, such as our inevitable subjection to emotional conflict.

Obviously the formulation of an agreed purpose for man as a whole will not be easy. But let us not forget that progress *can* be achieved. After the disillusionment of the early twentieth century

it has become as fashionable to deny the existence of progress, as it was fashionable in the optimism of the nineteenth century to proclaim its inevitability. The truth is between the two extremes. Progress is a major fact of past evolution; but it is limited to a few selected stocks. It may continue in the future; but it is not inevitable—man must work and plan if he is to achieve further progress.

Our optimism may well be tempered by reflection on the difficulties to be overcome. None the less, the demonstration of the existence of a general trend which can legitimately be called progress, and the definition of its limitations, is a fundamental contribution to thought; and we zoologists may be proud that it has been made, chiefly from the zoological side, by evolutionary biology.

Production and Technical Application of High Voltages

THE discussion on September 14 in Section A (Mathematical and Physical Sciences) of the British Association, on the production and technical application of high voltages, was one of those selected by the Council of the Association as having a direct bearing on the life of the community. The high-voltage transmission system connecting our major power stations, and the extensive use of X-rays in hospitals, are but two examples of the impact of high-voltage science upon society, and the extent of the applicability of this science is increasing rapidly. In no other science are physics and engineering more interdependent, and it is significant that nuclear physics would have been almost a closed book without the application of high voltages.

High voltages are familiar to us in four forms: low-frequency alternating voltages, unidirectional impulsive voltages, high-frequency alternating voltages and constant voltages. The engineer is for the most part concerned with the first three forms, the normal and the abnormal types of voltage appearing on transmission lines. The lines and the station apparatus of the 132 k.v. 'Grid' in Great Britain are tested up to two or three times normal line voltage with low-frequency alternating voltages, whilst abnormal voltages—such as surges due to lightning or switching operations—up to ten times normal operating voltage may appear on the lines. Thus engineering laboratories equipped to supply 500–1,000 k.v. at power-frequencies, and 1½ million volts from impulse generators, are necessary to test all apparatus for use on high-voltage systems, and to be in the van of immediate requirements. Constant potentials have been mainly used for radiography, X-ray therapy and physical research, and there appears to be an immediate need for voltages of the order of one million for research on nuclear physics and X-ray therapy.

There are many problems confronting the supply authorities of the 'Grid' which arise at the normal transmission voltage of 132 k.v. Among these may be mentioned the effects of corona, atmospheric pollution, gaseous discharge within the voids in so-called solid insulation, and power arc discharges initiated by atmospheric conditions and other causes, as enumerated by Mr. C. W. Marshall of the Central Electricity Board. The manufacturer is equally concerned with these problems and is constantly evolving new designs and new materials for use in high-voltage apparatus better able to withstand these destructive effects. Electrical gradients used in solid dielectrics are far lower than the theoretical permissible gradients referred to by Dr. S. Whitehead, of the British Electrical and Allied Industries Research Association (E.R.A.), on account of the inherent fluctuations in quality of dielectrics, our lack of knowledge of the behaviour of dielectrics over a period of many years when subjected to thermal changes and mechanical forces, and also on account of the dangerously high over-voltages which are known to occur on lines. It has been estimated that these over-voltages are responsible for 75 per cent of all failures of supply systems.

As Mr. R. Davis, of the National Physical Laboratory, pointed out, studies of the behaviour of dielectrics under impulse voltages are still in their infancy, there being so many variables influencing breakdown, such as wave shape and polarity of the applied impulse, electrode shape, and medium of immersion, temperature, and number of applied impulses. Moreover, our knowledge of the nature of surges arriving at terminal stations is all too meagre: information is being obtained by cathode ray oscillographs and lightning current recorders on lines all over the world, but effective measures are not yet available to prevent damage due to lightning. In this connexion it is interesting to note that the E.R.A. has available a 1¼ million volt impulse generator (Fig. 1) with which to study the effects of artificially produced surges on lines and cables, this voltage being adequate to spark over the line insulation of the

'Grid'. The effects of lightning currents of 100,000 amperes have yet to be investigated, and Prof. H. Norinder, of Uppsala, Sweden, gave a brief account of the surge current generator and the effects of large currents on electrodes and earthing materials.

In the realm of atomic physics constant potentials are favoured, as they will produce the most stable source of high-speed ions for nuclear disintegration experiments. The five-million volt generator built by Dr. van de Graaf represents the most outstanding example of high-voltage generation, but is only capable of producing one milliampere at full voltage. Thermionic valve circuits can give greater powers, but so far voltages much in excess of one million have not been produced by such means. For X-ray therapy, now so widely used in the treatment of all forms of tumours, voltages up to 250 k.v. have been used, but higher voltages are essential if the effects of short wave X-rays are to be compared with those of the much feebler γ-rays from 5-gram bombs of radium. A number of such high-voltage X-ray tubes is now in operation at voltages of 500–800 k.v. One of the most original and successful tubes has been made by Mr. Sloan in Berkeley, California, who conceived the idea of generating a continuous high-frequency alternating voltage in the same vacuum chamber as the filament and target of the X-ray tube.

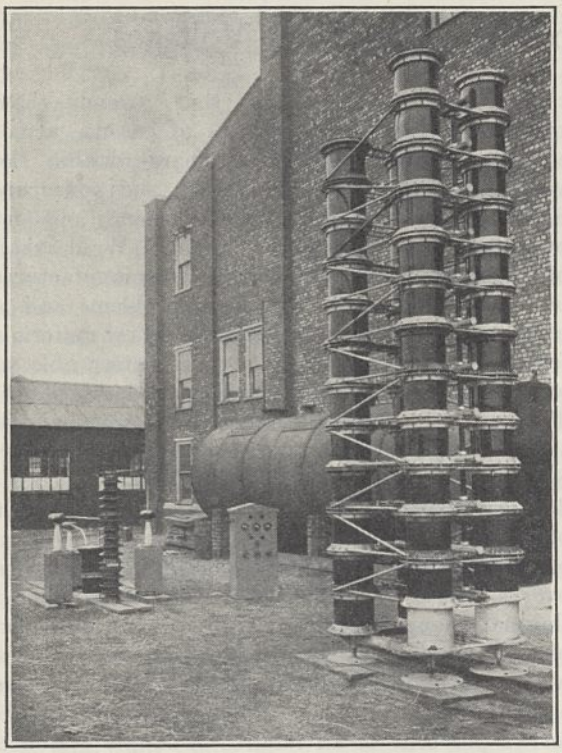

FIG. 1. 1½ million volt outdoor type impulse generator for use by the E.R.A. on the high voltage lines of the 'Grid'.

Dr. G. W. C. Kaye, of the National Physical Laboratory, described his recent researches on the measurement of γ-radiations, and announced that by using an ionization chamber large enough to absorb all the fast electrons liberated in air by the γ-rays, unification of the X-ray and γ-ray dosage measurements has been achieved. Of course, in practice it is not necessary to use a 'free air' chamber for the measurement of γ-rays or very high voltage X-rays; the 'free air' chamber may be replaced by a chamber having walls thick enough to absorb all the fast electrons.

An increasing use for constant voltage generators, widely affecting the community, is for the electrostatic precipitation of dust. Though a very old process of great simplicity, it has only recently been applied on a large scale for the detarring of gas, removal of poisonous fumes such as arsenic, and the elimination of dust from power-station flues. In one of the large municipal power-stations an electrostatic precipitator removes no less than 1,000 tons of dust per week which otherwise would be emitted from the chimney.

The measurement of high voltages presents a diversity of problems. Low-frequency alternating voltages may be measured by sphere spark-gap (a secondary standard) or by a crest voltmeter (a primary standard involving the measurement of the charging current of a standard condenser). The design of the condenser for one or more million volts presents the major difficulty as the condenser must be isolated from all sources of corona current. For lower voltages the condenser may be placed in a compressed gas chamber, or the new precision spark gap devised by Prof. W. M. Thornton may be used. This gap consists of parallel plates with rolled edges across which the field strength is uniform, so that sparking occurs with greater uniformity than occurs between spheres. For impulse voltages, however, this gap is not much superior to the sphere gap: an accuracy of one or two per cent is obtainable, provided that the spacing between spheres does not exceed the radius of the sphere and provided that the impulse wave front is at least one microsecond in duration. In shorter times than this, the gap measurement may be seriously in error, and the only reliable standard is the capacitance potentiometer and cathode ray oscillograph: the accuracy of measurement is then not greater than a few per cent. Constant potentials may be measured by the resistance voltmeter if sufficient power is available: for the electrostatic belt-type generator an electrostatic alternator voltmeter has been evolved which gives fair accuracy.

T. E. A.

The Architecture of Life

SECTION I (Physiology) of the British Association arranged a discussion at Blackpool under this title, in which Sections A (Mathematical and Physical Sciences) and B (Chemistry) took part. This discussion was concerned with some of the evidence bearing on the problem of the fundamental structure of the cells of animal organisms. In a wide and imperfectly explored field such as this, papers dealing with experimental data tend to appear rather unrelated and miscellaneous. What follows is not so much a summary of the papers as an impression of the main features of general interest.

Introducing the subject, Mr. A. D. Ritchie said that the advance of knowledge in the biological sciences depends upon an understanding of structure. In the history of science, the first stage was the development of anatomy, which revealed the relations and functions of those parts and organs of the body that are visible to the naked eye. The second stage was the development of microscopical technique which revealed the cellular structure of tissues, the functional relations of cells to one another, and, to some extent at least, the structure of the cells themselves. These methods have now accomplished most of their work. The third and the last advance will be the elucidation of the molecular architecture of the living cell. No possible improvement in microscopic technique can make structures so small as 10^{-5} cm. directly visible. The range of molecular magnitudes lies below this, say 10^{-6} cm.–10^{-8} cm. No one method of attack is going to reveal structures of this order, but only the co-operation of many different methods making use of all the resources of physics and chemistry.

Dr. D. M. Wrinch dealt with what is perhaps the central problem, that of the structure of proteins. The foundations of our knowledge have been laid by the labours of the organic chemists using the classical conception of Fischer, that proteins are built up of α-amino acids joined by the peptide linkage. Their results can now be extended by means of two new physical methods. By Svedberg's centrifuge method the size and shape of molecules of proteins in solution can be determined. By the X-ray method Astbury has obtained information about the molecular structures of keratin fibres and the protein of muscle, and Bernal about soluble crystalline proteins. The chief difficulty has been to understand the transition in structure from the globular form of the soluble crystalline state to the long chain structure of the denatured state and the fibres. The 'cyclol' scheme put forward by Dr. Wrinch gives promise of a solution. According to this conception the amino acids are linked in patterns of condensed six-atom rings. The possible patterns of this type are limited in number and their configurations can be worked out geometrically. The tautomeric change from the cyclol arrangement to the fully extended straight chain through the intermediary of folded chains becomes intelligible. There can be little doubt that all the ordinary proteins have the same kind of skeleton holding them together, so that a general solution of the structural problem is possible.

There is, however, a very different kind of protein-like material, the nucleo-proteins, the main structural constituents of the chromosomes of the cell nucleus. Geneticists have shown that the carriers of the hereditary characters are to be found here, and that they are specific and definitely localized. Fortunately, some chromosomes are so large that details of their structure are visible under the microscope. The molecular basis of the chromosome, Dr. Wrinch suggested, consists of bundles of straight chains of mainly basic amino acids bound together by combination with transverse bands of nucleic acid molecules—a suggestion that the most recent work tends to confirm.

Attached to the central structural skeleton shared by proteins in common are the side chains of the amino acids, which confer on each one its peculiar and specific properties. The importance of these specific properties comes to light in investigations of quite a different type. Dr. J. H. Quastel pointed out that for the catalysis of the chemical reactions brought about by living organisms, it is necessary to assume definite spatial arrangements of the enzyme systems concerned. Destruction of the normal cell structure stops some of the chemical reactions but not others. Experiments with bacteria have shown that while one chemical reaction can be blocked by the presence of an inactive substance on the active surface, another can proceed normally, so that the two must occur in different places and each place is specific for catalyzing one type of reaction. In the active cell there are simultaneous and successive reactions linked together in a way that implies not only definite patterns of reactive groups in the cell structure, but also some means for separating and restricting the diffusion of the soluble substances that undergo chemical change.

Dr. P. Eggleton's paper dealt with some aspects of this very difficult subject.

If a dead muscle is suspended in Ringer's solution, dissolved substances can diffuse freely into the whole of the water of the tissue. When the muscle is alive, most electrolytes can diffuse into one third only of the water it contains; the remaining two thirds are inaccessible to them. Glucose also has access to one third only, but urea can diffuse freely throughout. Histidine can diffuse throughout, but not its derivative carnosine. It is impossible at present to understand the partitioning mechanism underlying these facts, but some mechanism there must be.

The electrical potentials that are developed at cell surfaces are generally believed to be due to unequal concentrations of electrolytes on the two sides. The frog's skin develops such a potential between its two surfaces, but only so long as oxidative chemical reactions are going on, presumably to provide energy for maintaining a concentration gradient. Mr. O. Gatty has found that specific types of chemical reaction are necessary for this purpose, and is endeavouring to work out their course in detail.

Mr. J. S. Mitchell's experiments have been concerned with a rather special problem, the chemical changes in proteins brought about by ultra-violet light; but the method used is one of very general interest and great importance. It is to study the process in monomolecular films spread on a water surface. In such films the molecules can be definitely orientated and molecular structures and transformations may be studied directly. Many important cell constituents and other substances of biological interest can form monomolecular films, so that this very powerful method can be applied to them. A. D. R.

Obituary

Dr. J. B. Charcot

THE wreck of the polar yacht *Pourquoi Pas?* in a furious gale on the coast of Iceland on September 16, with the loss of all on board but one, was a tragic but not an inglorious end to a famous ship and to the life of the brilliant explorer whose career was so closely bound up with her for nearly thirty years.

Jean Baptiste Charcot was born in 1867, the son of a famous physician and neurologist, Prof. J. M. Charcot. He studied medicine in Paris and was for a time an assistant in the Pasteur Institute. Although he published several papers on medical subjects which were not without merit, circumstances determined that his reputation was to rest not on his professional achievements but on the outcome of his devotion to the sport of yachting.

Charcot's love of the sea brought him under the influence of the revival of polar exploration at the beginning of the present century and fired him to take a part. He raised funds for the purchase and equipment of a small ship, renamed the *Français*, for an arctic voyage, but changed the scene of his exploration to the Antarctic and sailed in 1903 with the intention of searching for the missing expedition of Otto Nordenskjöld in the Weddell Sea. When in South America he heard of Nordenskjöld's relief, and took the *Français* to the west side of Graham Land, there to continue the work begun by Gerlache in the *Belgica*. He reported the existence of Loubet Land south of Graham Land, and pushed on within sight of Alexander I Land; but the main value of the expedition lay in the physical observations and natural history collections made with the aid of his efficient scientific staff during two years.

On his return, Charcot secured Government support for a second expedition, and after a close study of the British, German and Norwegian polar ships, he had the *Pourquoi Pas?* designed to unite the best features of them all. In her he cruised for two years, 1908–10, to the west and south of Graham Land, giving precision to the somewhat nebulous lands seen from the *Français*. He explored the coast of a large island south of the Antarctic Circle to which he gave the name of Adelaide Island, believing it to be an extension of the small island so named by Biscoe in 1832. South of Adelaide Island he discovered a large inlet which he named Marguerite Bay and a new land south of Alexander I Land to which he gave the name of his father. These lands he could not approach, and he believed them to be islands lying off the Antarctic continent. As on the previous expedition, the main value of the researches on the *Pourquoi Pas?* came from the very extensive series of magnetic, meteorological and oceanographical observations and the collections of geological and zoological specimens.

After completing the publication of his results, Charcot continued to make oceanographical summer cruises in the *Pourquoi Pas?*, especially in the Greenland Sea and along the west of Scotland. He was one of the very small number of sailors to effect a landing on the remote islet of Rockall, 185 miles west of St. Kilda, and he acquired an intimate knowledge of the complex coasts of the Outer Hebrides. At the beginning of the Great War his Government insisted on placing him in the Army medical service, but he succeeded in proving that he was a better sailor than a surgeon, and received a commission in the French Navy. Later he was given command of

a British vessel with a combined French and British crew, and in her he rendered valuable service by preventing the establishment of enemy submarine bases in the desolate harbours of the west of Scotland which he knew so well.

After the War, Charcot continued to visit East Greenland on summer training cruises with young French sailors. He made a trip to Scoresby Sound in 1931 to select a site for the French station for the Polar Year observations of 1932–33, and afterwards transported the party of French physicists to and from the Sound. He rendered willing and efficient help to many of the recent Greenland expeditions. To young explorers Charcot was always a generous friend and a wise counsellor, and he gave the full benefit of his experience to Mr. Rymill of the British Graham Land expedition which is now in the field.

Charcot was a man of great personal charm and high culture. His literary style was clear and graceful, and his speeches on his many visits to England were always bright and to the point, for he had a perfect command of the English language and a gift for making enduring friendships. Apart from his scientific writings and his polar narratives, he was the author of a very attractive book on Christopher Columbus in which historical critics recognized the value of the interpretation of Columbus's voyages by a scientific man with a practical knowledge of seafaring.

Charcot's genius won for him full recognition as a leading man of science both at home and abroad. He was a member of the Institut de France and of the Academies of Sciences and Marine, received the gold medals and honorary membership of all the chief geographical societies of the world, and at the time of his death was president of the Paris Geographical Society. HUGH ROBERT MILL.

Dr. A. Anderson

DR. ALEXANDER ANDERSON, whose death at the age of seventy-eight years occurred on September 5, was a physicist and mathematician of note. He was professor of experimental and mathematical physics at University College, Galway, for almost fifty years. He was one of the last holders of the joint chairs of experimental and mathematical physics, a distinction shared with Prof. Morton of Belfast, who paid a graceful tribute to him in *The Times* of September 10.

Dr. Anderson was born in 1858. He studied in Queen's College, Galway (as it was then called), and graduated in 1880. He won an entrance scholarship to Sidney Sussex College, Cambridge, in 1881. He was sixth wrangler in 1884. After a short period in the Cavendish Laboratory under Sir J. J. Thomson, he was appointed professor at Galway in 1885. He became president there in 1899 and held both offices until his resignation in 1934.

Anderson is perhaps best known for his method of measuring self-inductance, which is in general use in laboratories of physics and electrical engineering. Two other of his methods have become standard practice, namely, his method of measuring surface tension and his method of measuring the viscosity of a gas. From 1890 onwards he published many papers in experimental and mathematical physics on optics, electrostatics, electromagnetics and relativity. Of his researches in experimental physics, possibly the most important is his contribution to the theory of contact differences of potential. In mathematical physics his papers mainly deal with new methods of approach to older theory.

The remarkable thing about Anderson was his really wide knowledge of experimental and mathematical physics and his continuous keenness as a teacher, especially of advanced students. I remember hearing the late Prof. McClelland, his most distinguished student, state many years ago that it was usual for his advanced lectures on mathematical physics to go on continuously for three hours, and this was his practice almost up to his retirement. He simply revelled in physical and mathematical problems. Personally Dr. Anderson was a most kindly man with a marked sense of humour. M. P.

Prof. Antoine Meillet

WE regret to record the death of M. Antoine Meillet, professor of philology at the Collège de France, and president of the Historical and Philological Faculties at the École des Hautes Études, Paris, which took place at Châteaumeillant (Cher) on September 22, at the age of seventy years. Prof. Meillet was born at Moulins (Allier) on November 11, 1866. He became a lecturer in the École des Hautes Études in 1891. From 1904 until 1906 he was a professor of the École des Langues Orientales Vivantes and in the latter year was appointed to the chair of comparative philology in the École de France. M. Meillet was regarded as one of the most eminent philologists of the day, his researches extending over the whole field of the Indo-European and Iranian languages. His "Introduction à l'Étude Comparative des Langues Européennes", first published in 1897, has been through many editions, the last appearing in 1934.

WE regret to announce the following deaths :

Prof. Henry Le Chatelier, For. Mem. R.S., and honorary fellow of the Chemical Society, on September 17, aged eighty-five years.

Brig.-General Sir Brodie Haldane Henderson, K.C.M.G., C.B., president in 1928–29 of the Institution of Civil Engineers, who designed the Lower Zambezi Bridge, on September 28, aged sixty-seven years.

Lieut-Colonel R. Knowles, C.I.E., acting director of the Calcutta School of Tropical Medicine, known for his work on medical protozoology, on August 3, aged fifty-two years.

Dr. A. H. Mackenzie, C.S.I., C.I.E., pro-Vice-Chancellor of the Osmania University, Hyderabad, who was a member of the recent Quinquennial Reviewing Committee of the Indian Institute of Science, Bangalore, on September 26, aged fifty-six years.

News and Views

The University of Sheffield

THE University of Sheffield, although only a little more than thirty years old, has taken an established place among the universities of Great Britain, and is attracting an increasing number of students. Recent years have witnessed some important developments and additions to the buildings, including a new department of mining, a school of dentistry, hostels for men and women and a new students' union. These additions have been largely due to specific gifts to the University. But in nearly all departments the present buildings are overcrowded. Teaching and research are carried on under conditions discouraging and hampering to both students and staff. Moreover, the limited resources of the University, imperilled by recent falls in rates of interest, limit the possibilities in securing the best men to fill vacancies on the staff and keep salaries below the usual level of other universities. To meet the urgent requirements for buildings, equipment and endowment, the University has issued an appeal for £250,000. Not less than £450,000 is required for complete fulfilment of requirements, but the lesser sum represents the minimum for outlay that is long overdue.

THE departments suffering most are medicine, geography, architecture, engineering and metallurgy. It is proposed to begin with the building of a new wing as part of a more comprehensive scheme. This wing will accommodate botany, zoology and geography, thus liberating other rooms occupied by these subjects. Engineering and metallurgy will find further accommodation by the acquisition of new land adjoining the applied science department of the University. The completion of these buildings would for a few years relieve a congestion that has become intolerable. But equally urgent is the provision of further space for the growing library. The present library, with space for only one year's normal addition of books and periodicals, and reading space for only a small number of students, must be extended. The proposal is to add to the library the present assembly hall, known as the Firth Hall, which is much too small for its present purpose and has very bad acoustic properties. This will entail the building of a new assembly hall of adequate size. For the main extensions the University already has the land but the houses that occupy it will have to be demolished. Some of them at present accommodate in small and unsuitable rooms departments in the faculties of arts and law. Further land, however, is urgently required for the extension of playing fields for the growing number of students. Plans for the completed university have been prepared by Mr. T. Lodge and are published in the pamphlet which the University has issued. The gift of large sums to the universities of other large industrial towns has set an example which it is hoped may be followed in Sheffield now that the economic depression seems to be passing. Contributions to the extent of £54,000 have already been promised, including a sum of £10,000 from Sir Robert Hadfield, to whom the University is already indebted for generous gifts in the past.

New Laboratory for Research in Aeroplane Materials

ON October 3, Mr. D. R. Pye, deputy director of technical development at the Air Ministry, formally declared open the laboratories of Aero Research Ltd., Duxford, Cambridgeshire, by setting in motion a press of 1,300 tons capacity. The ceremony was to have been performed by Mr. H. T. Tizard, chairman of the Aeronautical Research Committee, but he was unfortunately prevented at the last moment from doing so by illness. Aero Research Ltd. is a private research organization working in co-operation with Messrs. the de Havilland Aircraft Co. Ltd. and with the Department of Scientific and Industrial Research, chiefly on synthetic resin materials. A number of demonstrations was given of the properties of the materials developed, and it was shown that the apparent brittleness in static fracture is counterbalanced by a high energy absorption which results in a remarkable freedom from 'notch sensitivity'; at the same time the amorphous structure of the material gives exceptionally good fatigue properties. Controllable pitch airscrew blades were shown, designed and manufactured by the de Havilland Aircraft Co. Ltd. from material supplied by Messrs. Bakelite Ltd., which had withstood successfully severe tests in addition to sixteen and three quarter hours actual test flying (involving continual changes of pitch) and fifty engine backfires. Other demonstrations were given of X-ray apparatus, photo-elastic apparatus, special testing machines and of the utility of mass balancing in preventing wing flutter.

Records of Bird-Song

ON October 6 a private hearing was given by Messrs. H. F. and G. Witherby of some wonderfully successful gramophone records of British birds singing in their natural haunts. These are to be issued next week with a book on "Songs of Wild Birds" by Mr. E. M. Nicholson, said to be the first work to be published in Great Britain with auditory as well as visual illustrations. The records themselves were made by Mr. Ludwig Koch, with the assistance of Mr. C. Horton-Smith and the technical co-operation of the Parlophone Company. The material given on two double-sided disks, running for twelve minutes in all, has been selected from a large number of recordings. The practical difficulties to be overcome were obviously great, but the results obtained are well worth much labour. The songs of such musicians as the nightingale and blackbird are beautifully

reproduced ; the characteristic strains of lesser songsters like the chaffinch and willow-wren are faithfully recorded ; and the calls of cuckoo and dove—even the non-vocal drumming of the spotted woodpecker —lend pleasing variety. The quality is incomparably superior to that of previous records obtained from captive birds of a few species. These records will certainly give much pleasure and useful instruction : they may also provide valuable opportunities for analytical study of bird music. No doubt more will be made, for different kinds of birds, now that the example has been set. It is clear, too, that there are other subjects to which this interesting innovation of the 'sound book' may in future be applied.

Advances in Radium Therapy Technique

TELERADIUM therapy progresses in Great Britain, and more than one big unit is now established, for, apart from those centralized under the control of the Radium Beam Therapy Research, there is a 4 gm. unit at Westminster Hospital's Radium Annexe, where physicists and engineers have combined in devising an efficient form of distant electrical control. The radium container is suspended from a rotating beam bolted to a steel girder. This container weighs about 70 lb., and the transfer of the radium in it after application to the patients, to a massive safe for purposes of custody, is carried out electrically. There is no actual handling of the radium by any of the staff, the operator being 14 ft. from the patient's couch. Another interesting feature of the container used is that it carries a collar of platinum in order to reduce scattering of emergent rays to a minimum. These technical developments in the construction of big units of radium are very welcome, because the ordinary methods of protection for the personnel which are quite efficacious in the case of X-rays are inapplicable with penetrating gamma radiation.

The New Fulham Electrical Power Station

THE new power station at Fulham on the banks of the Thames was opened formally on September 26. It occupies an area of 15 acres and has a river frontage of 1,300 feet. It is an extension of the existing plant of the Metropolitan Borough of Fulham, but the disparity between its size and the demand required for the borough shows that the new station is an undertaking to serve the Grid. Two sets of 60,000 kilowatts each were installed this year and a third set is now being added. The boiler house is at right angles to the river and the turbine room is parallel to the river. Two white reinforced concrete chimneys three hundred feet high are already built, and when the station is completed there will be four of them. Three colliers have been ordered, each of them capable of carrying 2,300 tons of coal, and the jetty has three travelling cranes each capable of handling 175 tons an hour. The cranes pass the coal to weighing machines, whence it is fed to the furnaces on two belt conveyors which run at 300 feet per minute. Using only two cranes enables a collier to be unloaded in 6½ hours. When complete and working at approximately half its maximum power, the station will consume roughly 2,000 tons of coal per day. The final fleet of colliers will consist of six boats capable of sea voyages and of passing under the seventeen bridges up the River Thames to Fulham. The new station has a dignified appearance and in conjunction with the Battersea power station on the opposite bank of the Thames will enable the Central Electricity Board to balance the London load.

THERE has been considerable opposition to the location of 'super' stations in urban areas, mainly on the ground that their chimneys emit grit and noxious vapours. But the gas washing plants at Fulham are so efficient that this objection has little weight. Each boiler is provided with sulphur extraction plant in the form of two separate units each provided with a separate induced draught fan. The sulphur extraction plant employs grid packing irrigated by a liquor containing suitable alkali so as to maintain intimate contact between the boiler gas and the washing liquor. The liquor system is known as the Howden non-effluent system. The washing medium is constantly recirculated and purged in order to keep the concentration of solid at the best value. The solids extracted are dealt with by a separate and external settlement plant. The amount of liquor recirculated through a complete washer for one boiler unit is 13,000 gallons per minute. Each complete plant is capable of handling 105,000 cubic feet of gas per minute, and the extraction efficiency for sulphur and grit is 98 per cent if the coal have a maximum sulphur content of 1·7 per cent.

The Electricity Grid

MR. H. HOBSON, in a paper read to the recent World Power Conference at Washington, pointed out some of the advantages that have accrued to Great Britain from the electricity grid. The present trend of the national output of electric supply makes it clear that, before the end of the first ten years of its operation, the system will have effected great economies without cost to the country. In the last three years alone, fuel costs per unit have been reduced 15 per cent and thermal efficiencies have risen more than 12 per cent. In 1925 the reserve generating plant was about 2 million kilowatts, against an aggregate maximum demand of less than 3 million. Last year the reserve showed no increase although the aggregate maximum demand was greater than 6 million. There is one point that is being seriously considered by the Air Raid Precautions Department of the Home Office. There is no doubt that the grid with all its associated superstations will be much more vulnerable to aircraft action in war than the old regime with its independent power stations and few overhead lines. Anti-aircraft forces would doubtless be a help, but permanent protection by camouflage or otherwise would be very difficult. Unless a super-power station were taken absolutely by surprise, palliative measures could be devised to prevent damage to the stations linked with it.

Estimates of Future U.S. Power Supplies

SOME conclusions from the reports given at the third World Power Conference as to how long

petroleum, coal, natural gas and water power will last in the United States, have been issued by Science Service, Washington, D.C. There is a possibility of a shortage of domestic petroleum so early as 1940, and by 1945 the shortage may be serious. There is no cause for alarm in the figures reported, but wasteful methods of drilling and using are deplored. The question of coal conservation is considered immediate and urgent. The life of the coal resources at the recent maximum demand is about 2,000 years. With the probable increased demand of the future, the life may be measured in hundreds of years only. For natural gas the known domestic reserves are seventeen to twenty times the annual consumption. For water power, only a small percentage of the total potential hydro-electric power has yet been developed; but in making estimates, many other factors have to be considered in connexion with navigation, recreation, wild life, soil conservation, etc. One of the reports suggests the possibility of replacing all the 'manufactured gas', usually made from coal, with the by-product gas of petroleum refineries. The second most important gas resource of America is the nearly 200,000 million cubic feet of gas which has been stripped of all the condensable constituents that can be used in motor fuel. In the generation and distribution of electric power, engineers have effected notable economies in fuel consumption and the use of materials. This is a conservation step in the right direction, but many engineers think that more careful engineering is required in the mining of coal to reduce waste. Power is also used for purposes that constitute only a waste of what the engineers have so economically produced.

Enzymologia

It is with mixed feelings that we extend a welcome to yet another scientific journal. *Enzymologia* is edited by Dr. Carl Oppenheimer, assisted by an international group of distinguished collaborators, and bears the imprint of Dr. W. Junk, of The Hague, on its cover as publisher. It is to be an international monthly journal for the publication of researches relating to the enzymes. Two parts appeared, in July and August, containing twenty papers in English, French and German, and it is stated that two further parts are in the press. The subscription price for the volume of about 400 pages in six parts is 15 Dutch florins. We write "mixed feelings" because all of us, including the libraries which are the chief subscribers to the periodical literature nowadays, agree there are already too many journals both to read and to purchase. The advantages to the specialist in having his reading mainly provided for him in one journal are considerable, but against this must be set the inevitable curtailment of his general reading, tending to produce a narrow outlook. Notwithstanding these remarks, it is clear that a welcome awaits a journal devoted to progress in enzyme chemistry, the more especially since this is a field which is due for intense cultivation, leading to marked progress during the next few years. *Enzymologia* in no way conflicts with the now popular "Ergebnisse der Enzym-Forschung", which is an annual summary. The issue of the new journal from The Hague is one more example, if such indeed were needed, of the progress of biological chemistry in Holland; the first issue begins appropriately with a contribution from a distinguished Dutchman, Prof. A. J. Kluyver of Delft.

Conversazione of the Quekett Microscopical Club

By kind permission of the Royal Society, the Quekett Microscopical Club is holding its annual conversazione in the rooms of the Royal Society at Burlington House at 7 p.m. on Tuesday, October 13. Not only will there be a large number of exhibits staged by members of the Club, but also the Committee responsible for the organization of the conversazione has been fortunate in enlisting the sympathy and co-operation of other well-known scientific workers and microscopical clubs. The Royal Society is exhibiting original communications from Van Leeuwenhoek and drawings by Hooke. In addition, exhibits have been received from the Natural History Society of Cape Town, from the Microscopical Society of Victoria, Australia, from microscopists in France, the United States and various microscopical societies in Great Britain. A series of cinematographic exhibits on microscopical, pond and other life, also of the development of the bird ovum, will be given at intervals during the evening by Messrs. Kodak, Ltd. Cards of admission can be obtained on application to Mr. W. S. Warton, 35 Doneraile Street, London, S.W.6.

The Osborne Reynolds Ridge

Since the letters on the subject appeared in Nature, the Reynolds line has been seen by readers both on fresh-water and sea-water. Some of those who have seen it, however, missed the note in the News and Views columns of the July 4 issue (p. 20), giving references extending back to a paper by Prof. Osborne Reynolds. Mr. K. G. Denbigh, of Draidland, Norton Road, Norton-on-Tees, Durham, has sent an account of his observations. He saw the line at the fort of Carrawburgh, where a spring rises in a circular pool about five feet deep and eight feet in diameter. It formed a loop, roughly circular and about twelve inches across, surrounding the spot where the water rising from the bottom broke the surface. Apart from this small area where the water was perfectly clear, the pool was, no doubt, covered with a film; he refers to pollen grains and other small vegetable matter floating on it. As Reynolds explains in his paper, the line is only stationary if the rate of spreading of the film over the clean surface of the water is balanced by the outward motion of the water. Mr. Denbigh found that the loop was sensitive to wind, contracting to a point when disturbed and expanding again when the wind died down. He also noticed and sketched the distortion of reflections of reeds where they appeared to cross the line. He watched the line for nearly an hour, until a few soap shavings thrown into the water proved to be an overdose for this sensitive phenomenon.

Progress in Seismology

THE forty-first report of the British Association Committee on Seismological Investigations includes many points of interest. A brass sphere, 18 inches in diameter, has been made by Messrs. Casella for use in the determination of epicentral distances. The positions of observatories are marked by holes and the sphere has been chromium-plated. The Committee is indebted to Mrs. H. H. Turner for providing most of the accessories that will be used in ascertaining the distances and azimuths of the epicentres. Four small earthquakes were felt in the British Isles since the last report was presented, in the Channel Islands and at Leigh, Comrie and Kinlochewe. The earthquakes in the island of Montserrat continue, though they were less frequent during the first half of 1936 than in the two preceding years. A Wiechert horizontal seismograph has been installed, in addition to a number of Jaggar shock-recorders that were made at Kew Observatory for the use of the expedition sent out by the Royal Society. The preparation of the International Seismological Summary for 1931 has been completed, and the sections for the first half of the year have been printed and distributed. The number of earthquakes included is 297. References are also made to Dr. H. Jeffreys' revised table of transmission times recently published by the Bureau Central de Séismologie, to the unusually long seismic waves associated with the South Pacific earthquake of June 26, 1924, and to the Baffin's Bay earthquake of November 20, 1933.

Megalithic Monuments of South Wales

THE latest addition to the Megalithic Survey of England and Wales ("Map of South Wales showing the Distribution of Long Barrows and Megaliths". Compiled by F. W. Grimes. Southampton : Ordnance Survey. Pp. 56 and Map : Scale 4 miles to 1 inch. 5*s*., 5*s*. 6*d*. and 6*s*. 6*d*. net) incorporates the results of a survey of the area covered by Sheet 7 of the Quarter-inch Ordnance Map. It is now possible for the first time, as the Director-General points out in an introductory note, to assess the distribution of the megalithic monuments of an area which has been recognized as an important centre of the culture. This region, predominantly upland, and, therefore, differing essentially from others already covered by the series, falls into two parts, a narrow coastal plain of undulating country, seldom more than 400 ft. above sea-level, in which the monuments are mainly found, and an upland, which attains its greatest heights in Brecknock Beacons, and of which a large part is above the 1,000 ft. contour line. Mr. Grimes discusses a number of questions arising out of the distribution of the monuments, not the least interesting being those relating to his omissions, a matter with which he proposes to deal at greater length elsewhere. He also raises a question of wide general interest in connexion with Stonehenge. One of the most noteworthy contributions to British archæology of the post-War years was the conclusion, at which the late Mr. H. H. Thomas of the Geological Survey arrived in 1923, that the blue stones of the inner circle at Stonehenge were igneous rock derived from the Presely Mountains and the altar stone micaceous sandstone of either the Cosheston Beds around the estuary of Milford Haven, or the Senni Beds of Carmarthen and Brecknock ; but up to the present no satisfactory hypothesis as to the method of transport and route has been offered. Mr. Grimes discusses the question in the light of his survey and gives his reasons for suggesting a route by both land and water in which transport from the Presely Mountains to the sea was effected by one of three possible ancient roads which he shows.

Aleutian Islands' Skull of Abnormal Size

DR. ALEŠ HRDLIČKA, it is reported by the Smithsonian Institution, Washington, D.C., in the course of excavations on the Aleutian Islands, has brought to light a skull of remarkable size. Its cubic capacity is said to be no less than 2,005 c.c. This is the second highest skull capacity recorded, the largest being that of Turgenev, the Russian novelist, whose skull has a capacity of 2,030 c.c. Skulls of known capacity ranking next are those of Daniel Webster, 2,000 c.c., Bismarck, 1,965 c.c., La Fontaine, 1,950 c.c., Beethoven, 1,750 c.c. and Kant, 1, 740 c.c. The enormous, but imperfect, South African Boskop skull, according to one estimate, has been rated at 1,950 c.c. ; but a more conservative figure places it round about 1,700 c.c. Dr. Hrdlička's excavations on the Aleutian Islands, in the course of which the present find was made, are in continuation of a series of investigations of the archæology and physical anthropology of the present and former inhabitants of Alaska and the adjacent islands, upon which he has been engaged on behalf of the Smithsonian Institution for successive seasons during a number of years. His object is to elucidate the racial affinities and chronological succession of the early peoples who migrated from north-eastern Asia to populate America. On this problem, unfortunately, his latest discovery, apart from the probability that it is no more than an individual instance of abnormal development, would appear to throw no certain light, owing to the absence of the facial skeleton.

Human History and Geographical Discovery

IN his presidential address to the British Academy in July last (London : Oxford University Press. 1*s*. net) Mr. J. W. Mackail said that we are at the beginning of a new era of discovery and interpretation which is revolutionizing the whole aspect of human history. Civilizations of the past in every continent are yielding up more of their secrets. Byzantine history, art and institutions have emerged from comparative neglect to an important place in humane studies. The past ages of India, China and Japan and even Central Asia are revealing their significance. The greatnesses of Central and South America are taking their place in the panorama of the past, and undiscovered Africa and impenetrable Arabia no longer exist. But important as are the acquisition and tabulation of knowledge, the primary function of humanism is the appreciation, in the largest sense of the word, of the classics of art, music, philosophy,

history and creative invention over the whole range of life as throughout the whole range of literature. The danger which menaces learning is not that of conflict of sectional interests but of a general relapse into barbarism. It is not needless to reaffirm once more our emphatic and uncompromising support of all efforts to maintain the free development of the human intellect, unhampered by autocratic interference.

Avon Biological Research

THE third Annual Report, 1934–35, describing the continuation of work on the lines approved by the Avon Co-ordinating Committee, has recently been published (University College, Southampton. Avon Biological Research. Annual Report, 1934–35. Pp. 126+3 plates. Southampton: University College, 1936. 2*s*. 6*d*.). The work is conducted at University College, Southampton, where there are special laboratories set aside for the purpose, and on various parts of the river; the main purpose being salmon research and its branches, although trout research is also included. The salmon research is approved by the Development Commissioners, who since October 1934 have kept it under their official supervision, the Treasury having granted a sum towards the expenses enabling, among other things, a junior research officer to be appointed. Much help is acknowledged. Colonel Bennet-Stanford has erected a hatchery and provided facilities for the freshwater rearing of salmon in his lakes at the head waters of the Nadder, a tributary of the Avon, more than fifty miles from the sea, and many others have assisted substantially, both financially or by individual work and advice. A rotating fish screen (described in the appended papers) has been set up on Major Napier's land at Fordingbridge, where also are experimental spawning beds. East Mill still remains the headquarters of the river. The general report deals with the importance of vermin, artificial propagation and smolt migration. Appended papers include "British Mammals and Birds as Enemies of the Atlantic Salmon" (a most interesting and important summary), and "Importance of Iodine in Relation to Fish", besides accounts of hatching and stocking experiments and of scales from the Avon trout and grayling.

Useful Birds

THREE new Advisory Leaflets dealing with some British birds of prey have been issued by the Ministry of Agriculture and Fisheries. One describes the appearance and activities of the buzzard, another those of the long-eared and short-eared owls; and in the case of each of these birds the decision is that it is beneficial and worthy of careful protection. The third leaflet discusses the tawny or brown owl and the little owl; while the former is regarded on the whole as doing more good than harm, the little owl, although it also destroys pests, has become too plentiful in many districts on account of the loss it causes to poultry-keepers and others, and is therefore in no need of protection. These leaflets with their excellent illustrations by G. E. Lodge should be widely distributed in schools; they form the best sort of propaganda for bird protection.

Destruction of 'Vermin' in Bedfordshire

LUTON MUSEUM has performed a useful service in publishing a summary of "Bedfordshire Vermin Payments", extracted by J. Steele Elliot from the records of parish officials during the sixteenth to nineteenth centuries. A recent note in these columns referred to the exceedingly limited distribution of the pine-marten and polecat in Britain at the present day; but up to 1808 the pine-marten was being killed, at 2*d*. a head, in Bedfordshire, and in forty-two parishes payment was claimed on a total of more than 6,000 polecats, the most recent record in these accounts being in 1835. It is a sorry tale of extermination.

Indian Wild Life: a New Magazine

IN an effort to encourage wider sympathy with wild life in India, a group of enthusiasts has published *Indian Wild Life*, the official organ of the All India Conference for the Preservation of Wild Life. The objects of the Conference are ambitious: to give effect in all parts of India to the provisions of the All India Convention of 1935, to encourage the preservation of fauna and flora, popularize natural history in schools, establish a natural history library, and an exchange system of literature, to establish a National Park and to publish books and pamphlets on Indian natural history, and to disseminate literature in different languages. It is a big programme, but it is worth aiming at, and well worth encouraging. To the mind of a Western reader, too great a part of the new magazine is given up to personal paragraphs, but it is encouraging to find that already one of its objects has been fulfilled, and that a United Provinces National Park is an accomplished fact—the only Park of its kind in India.

British School of Archæology at Rome

IT is announced that Mr. C. A. Ralegh Radford has been appointed director of the British School of Archæology at Rome in succession to Mr. Colin Hardie, recently appointed fellow and classical tutor of Magdalen College, Oxford. Mr. Radford is a former student of the British Schools of Archæology at both Athens and Rome; and by his excavations on prehistoric Roman and medieval sites in Britain and abroad has taken a prominent part in recent advances in archæological studies. He was appointed Inspector of Ancient Monuments for Wales and Monmouthshire in 1929, and is also a member of the Royal Commission on Ancient Monuments of that area. As general secretary with Prof. V. Gordon Childe of the First International Congress of Pre- and Protohistoric Sciences he was jointly responsible with him for much of the success of the session held in London in 1932. Mr. Radford's training and experience have been such as should enable him to preserve the necessary balance between the studies of the School in prehistoric, protohistoric and classical archæology, to which the special circumstances of Rome are perhaps less conducive than those of Athens.

Television Demonstrations in London

EXPERIMENTAL television programmes are being transmitted by the B.B.C. until further notice between 11 a.m. and 12 noon and 3.0–4.0 p.m. daily. A demonstration television receiver has been installed at the Science Museum, South Kensington, upon which the B.B.C. transmissions from the Alexandra Palace are received. The receiver has been lent by Messrs. A. C. Cossor, Ltd., and is of the type which is now available to the public for home reception. A special aerial has been erected on the roof of the Museum, and the receiver has been installed in one of the basement galleries where provision has been made for visitors to see the demonstrations. The Southern Railway has also provided television receivers at Waterloo Station for the use of ticket-holders.

Announcements

THE Thomas Hawksley Lecture of the Institution of Mechanical Engineers will be delivered on November 6 by Prof. A. Fowler, who will take as his subject "The Spectroscope and the Atom".

THE council of the Illuminating Engineering Society has awarded the Gaster Memorial Premium to Mr. Ralph G. Hopkinson, for his paper on "The Photographic Representation of Street Lighting Installations", read before the joint meeting of the Illuminating Engineering Society and the Royal Photographic Society last December; and the Silver Jubilee Commemoration Award to Mr. W. R. Stevens, for his experimental work on "Thermal Endurance of Illuminating Glassware".

THE Masters Memorial Lectures of the Royal Horticultural Society will be given in the lecture room of the Society's New Hall in Greycoat Street, Westminster, on October 27 and November 10, at 3.30 p.m., by Dr. Redcliffe N. Salaman, on "The Potato in its Early Home and its Introduction into Europe".

DR. PASTEUR VALLERY-RADOT, a distinguished Paris physician and grandson of Pasteur, who is well known for his work on anaphylaxis and asthma, has been elected a member of the Paris Academy of Medicine.

DR. ETIENNE BURNET, formerly assistant director of the Pasteur Institute of Tunis and expert in the public health organization of the League of Nations, has been nominated director of the Pasteur Institute at Tunis in succession to the late Dr. Charles Nicolle.

THE Riberi prize, founded by an Italian surgeon, for the best contribution to the progress of medicine within the last five years, has recently been awarded to Dr. Francesco Pentinalli, professor of general pathology at Florence, for his work on experimental tumours and cancer. The articles submitted for the prize numbered 273 and emanated from 38 contributors from nine different countries.

THE Indian Science Congress, which will be held at Hyderabad on January 2–8, 1937, will consist of sections of mathematics and physics, chemistry, geology and geography, botany, zoology, anthropology, agriculture, medical and veterinary science and physiology and psychology. Further information can be obtained from Dr. H. Hyder Ali Khan, Medical College, Osmania University, Hyderabad.

THE Central Office of the World Power Conference, 36 Kingsway, London, W.C.2, announces that it will publish on October 28 the first number of the "Statistical Year Book of the World Power Conference" (price £1). This volume will contain an inventory of the power resources of the world, and annual statistics, relating to 1933 and 1934, of the production, stocks, imports, exports, and consumption of solid and liquid fuels, natural gas, water power, and electricity.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A technical officer for experimental work with ground and aircraft radio direction-finders at the Royal Aircraft Establishment, South Farnborough, Hants—Chief Superintendent, quoting No. A. 243 (October 12).

A lecturer in mining subjects in the Municipal College, Burnley—Director of Education, Educational Office, Burnley (October 12).

A lecturer in the Department of Architecture, Building and Structural Engineering, Rutherford Technical College—Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (October 14).

Chemists (male) and a junior assistant chemist (male) at H.M. Factory, Irvine—Under-Secretary of State (C. 5), War Office, London, S.W.1 (October 17).

An assistant lecturer in the Aeronautics Department, Imperial College of Science and Technology, S.W.7—Secretary of the College (October 17).

An assistant biochemical engineer in Saorstát Alcohol Factories, Irish Free State—Managing Director of the Factories, Department of Industry and Commerce, 14/15 St. Andrews Street, Dublin (October 17).

An assistant lecturer in engineering at the School of Mines, Treforest—Director of Education, County Hall, Cardiff (October 19).

A civilian technical officer in the Department of Scientific Research and Experiment, Admiralty—Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1, quoting C.E. 6024/36 (October 24).

A library assistant at the Research Department, Institution of Automobile Engineers, Great West Road, Brentford, Middlesex.

Engineers for the Public Works Department (temporary staff) of the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/4500.

A lecture assistant and laboratory steward for the Chemistry Department, Sir John Cass Technical Institute, Jewry Street, London, E.C.3—The Principal.

A lecturer in theory of structures and structural design, and a lecturer in electrical engineering at the Medway Technical College, Gardiner Street, Gillingham—Mr. C. Colles.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 646.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Diffraction of Light by Ultra-Sonic Waves

F. H. SANDERS[1], in a recent note in these columns, has reported excellent agreement between our theory and his experimental results. His note, however, calls for a statement from us clarifying the theoretical position. As is well known, Debye and Sears in America and Lucas and Biquard in France discovered, in 1932, that a beam of light after passing through a supersonic field breaks up into a fan of diffraction spectra. Following this discovery, Prof. R. Bär, of Zurich, carried out extensive investigations regarding the nature of the phenomenon; he obtained numerous beautiful results concerning the manner in which the relative intensities of the various diffraction spectra depend on the wave-length of light, the supersonic intensity and the thickness of the cell. He also discovered that the frequencies of light in the diffracted spectra are modulated by the sound field in a very peculiar manner depending on the order of the spectrum.

As has been remarked by many investigators, these results of Bär, and even the appearance of a large number of diffraction spectra, found no explanation in terms of the theory of Brillouin. Indeed, the existence of higher orders had been erroneously ascribed to the existence of overtones in the supersonic field. In the theory of Lucas and Biquard, which was mentioned by Sanders in his note, the laws of geometrical optics were applied to the problem, and it was assumed that the individual rays of the incident light follow paths independent of one another. This theory ignores the interference effects which are fundamental to the problem, and does not succeed in explaining the characteristic features observed in experiment.

The theory of the phenomenon initiated by us is set out in a series of papers[2]. At the outset, our purpose was to develop a theory of the simplest possible character which would satisfactorily account for Bär's experimental results. A simplification was effected by assuming that the wave-length of the sound is not too small and the thickness of the cell is not too large; in which circumstances, it can be shown theoretically from Fermat's principle that only the phase changes occurring in the passage of light through the cell need be considered. Indeed, Bär[3] reported later that the results in our papers I, II and III agreed qualitatively with most of the observed features of the phenomenon even in the general case, and in a perfectly quantitative manner when the experimental restrictions postulated by us were actually satisfied. In our papers IV and V, the restrictions mentioned above were dispensed with and the theory of the phenomenon was developed quite rigorously on the basis of the electromagnetic wave-equations. This general theory has been fully worked out by one of us (N. S. N.) and leads to a satisfactory explanation of some remarkable experimental results obtained by Dr. S. Parthasarathy[4] at this Institute. It is found that, when the light is incident obliquely to the sound waves and the latter are of sufficiently high frequency, the intensity of the diffraction spectra shows very marked asymmetry and that particular orders attain maximum intensity at characteristic angles of incidence given by a formula of the Bragg type. This is in agreement with the deductions from the theory.

Another aspect of the problem has been worked out by one of us (N. S. N.) in a paper now under publication. It has been explained why the supersonic waves can be seen directly through a microscope focused on a plane to the rear of the sound-wave cell. The theory predicts the interesting result that the grating-like pattern observed through the microscope repeats itself periodically as the focal plane of the microscope is moved away from the cell by integral multiples of a definite distance. This prediction has been confirmed quantitatively in a very recent (as yet unpublished) investigation made at this Institute by Dr. Parthasarathy. Other peculiar features of the sound field as optically observed—for example, a doubling of the number of fringes in certain positions of the microscope, and a disappearance of the fringes at certain other positions—are also indicated by the theory and are beautifully confirmed by the experiments.

C. V. RAMAN.
N. S. NAGENDRA NATH.

Department of Physics,
Indian Institute of Science,
Bangalore.
Sept. 9.

[1] F. H. Sanders, NATURE, **138**, 285 (1936).
[2] C. V. Raman and N. S. Nagendra Nath, *Proc. Ind. Acad. Sci.*, **2**, 406 and 413 (1935); **3**, 75, 119 and 459 (1936). N. S. Nagendra Nath, *Proc. Ind. Acad. Sci.*, **4**, 222 (1936).
[3] R. Bär, *Helv. Phy. Acta*, **9**, 265 (1936).
[4] S. Parthasarathy, *Proc. Ind. Acad. Sci.*, **3**, 549 (1936).

Surface Markings on a Diamond

ACCORDING to the mosaic hypothesis, it is postulated that the uniform lattice structure of an ideal crystal is interrupted over narrow regions distributed periodically throughout the crystal at distances large compared with the size of the unit cell. Various forms of the hypothesis have been devised to explain anomalies in the intensity of reflection of X-rays, breaking strength and other 'structure-sensitive' properties of crystals, but the subject is at present highly controversial. Whilst many facts undoubtedly fit the hypothesis, several workers claim that some half dozen other types of fact do not fit[1]. All forms of the hypothesis including the 'lineage structure' proposed by Buerger[2] would predict non-uniformity

(*Continued on p.* 641.)

NATURE

SUPPLEMENT

No. 3493 SATURDAY, OCTOBER 10, 1936 Vol. 138

William Stukeley on Newton

Memoirs of Sir Isaac Newton's Life by William Stukeley, M.D., F.R.S., 1752: being some Account of his Family and chiefly of the Junior Part of his Life. Edited by A. Hastings White. Pp. xvi + 86 + 3 plates. (London: Taylor and Francis, 1936.) 5*s*. net.

WE have reached a position when biography is taken seriously. Imagination is wanted; but in the case of great men, it is not enough to be imaginative; one requires to scrutinize the sources themselves in readable form.

William Stukeley owes his fame to Newton. He was an antiquary. According to the "Dictionary of National Biography" he is chiefly known to the public by one of his errors in reading a coin, which is the wrong thing for an antiquary to be known by. He was a friend of Newton; a Lincolnshire man like Newton. He was also at Cambridge. Though considerably Newton's junior, he afterwards saw much of Newton in London, and acquired an almost oppressive admiration for him. He afterwards went to Grantham, where he was in a favourable position to learn the truth of various stories. Hence when Conduitt, who married Newton's niece, wrote to several friends for their recollections, Stukeley was among the number, and responded.

We owe the present publication to Mr. A. Hastings White, consulting librarian of the Royal Society, to whom, as the superintendent of the British Museum Reading Room says in the foreword, "the thanks of students in so many branches of learning are due for his scholarship and never-failing readiness to help".

Mr. L. T. More regards Stukeley as "the principal source of our knowledge of Newton's personal life"; he also speaks later of Stukeley as "trustworthy"—one would add, if you take a grain of salt with his stories. He seems to have been a pre-scientific antiquary. Of Woolsthorpe, he writes, "This Mannor of Wulsthorp probably belong'd to Ulfus and took its name from him", and embarks on a page and a half about Ulf, decorated by an "in all probability" and an "I suppose". From the frontispiece to this volume, Stukeley looks a pleasant, good-humoured man. He had great opportunities, but I do not think he made the best use of them. He does not seem to have taken himself too seriously. He gives a sketch of Woolsthorpe as it was in his day, and says the house was rebuilt "not so large a form as the old house", from which we infer that the cut given in Brewster does not represent the house in which Newton was born. One would suppose that Brewster's well-known talent for inaccuracy lay in wait for him on an unnecessary occasion. But other people's boots are on the wrong feet too. Stukeley himself was not meticulously accurate. Mr. White gives an allegorical portrait of Newton by Stukeley, supported by a nude and dubious Urania (if it *is* Urania), with as many breasts as Stukeley can find room for, irrespective of the possibilities of anatomy, though Stukeley was, among other things, a medical graduate and a practising doctor.

One requires to be pretty clear as to *which* of Stukeley's writings the present volume is. Stukeley went to Grantham in 1726, the year before Newton died, and began collecting traditions. When Newton died, Conduitt wrote and asked him to contribute his collections, and Stukeley mostly sent these to Dr. Mead, who had attended Newton in his last illness. These apparently figure among the "Catalogue of Portsmouth Papers" (p. 44, No. 109), and they were auctioned with the rest by Messrs. Sotheby when the Portsmouth Papers were sold on July 13–14 of this year. Brewster

consulted them, and also L. T. More. But Stukeley also made, apparently, two drafts of his letter to Mead in 1727, and kept these by him until 1752, perhaps completing them and perhaps allowing ample time for second thoughts. He drew these up twice over, under three heads. The heads should make for clearness; but they do not. They are rather conflicting, and one does not discover in the contents much trace of them. He put in the dedication, but he never seems to have taken any steps as to publishing them. One learns from the foreword to the volume under notice that Stukeley's own papers were auctioned in 1931, that is, before the Portsmouth Papers were dispersed. Afterwards, the chief MS. found its way to the Royal Society, where Mr. White copied it out and published it in the volume before us. Hence there are at least two documents by Stukeley, and one must compare, as well as one can, the present volume with what has passed through the sieve of Brewster and L. T. More, to find out whether they agree, Stukeley's papers in the Portsmouth collection not being now available elsewhere.

The result of this comparison is that the two are remarkably alike, though not quite verbatim. On the whole, we learn very little new from them, and what they do say, we would like to see confirmed from other sources. One would gather from the account of Newton's rich relations that he was always in opulent circumstances, which does not tally with his going to Trinity College in the capacity of a sizar. Among the major things we learn are that Newton was of a cheerful disposition; that he was very much attached to Grantham; that he was talkative among his own countrymen; that he was very much interested in plants and was in the habit of going "simpling"; that he used to be a good draughtsman when young; that when he had a cold, he stayed in bed until it was over;—all things that might be told of anybody. "Give me of Nelson only a touch, And I keep it, be it little or much." It is none the less a book to be read, as giving a picture of Newton and his personal habits, as he seemed to one who had seen him in the flesh. We are indebted to Mr. White for its publication.

One thing we get is a clue to the origin of the verses which Newton's former love, Mrs. Vincent, used to repeat when eighty-two years of age, which Brewster and also L. T. More attribute to young Newton, namely, they were copied out of *Eikon Basilike*, along with the drawing of King Charles I which is their subject. R. A. S.

The Naturalist Outlook in Psychology

The Natural History of Mind

By A. D. Ritchie. (Tarner Lectures delivered in Trinity College, Cambridge, 1935.) Pp. viii+286. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 15*s*. net.

THE title of this book is significant, indicating, as it does, that the author proposes a return from all the sterile systems of psychology that derive from the Cartesian separation of mind and body to the naturalistic outlook of Aristotle. He is in good company, and one of an increasing band of students of the biological sciences who, whether philosophically minded or not, are already upon the same road.

Mr. Ritchie, however, is philosophically minded, and makes use of his science to lead up to problems, vital for all philosophy, that emerge most clearly, though not exclusively, in psychology. Indeed, these are the very problems from which psychology originally arose, when men first began to speculate about the value of any kind of knowledge and the binding force of any kind of law. So far, however, as psychology is concerned, they remain problems to the end; for though this science still investigates the origin and growth of knowledge, and the belief that some actions are right and some wrong, it is left to philosophy to discuss the ultimate validity of the one and the ethical status of the others.

Because of this common sharing of subject-matter, Mr. Ritchie maintains that psychology must always remain "intimately connected with philosophy, as in the past". This is open to criticism; for, if a distinction is drawn between subject-matter and formal subject-matter, and between proximate and ultimate problems and principles of solution, the science of psychology could be differentiated from philosophy in exactly the same way as the other sciences are differentiated from it. Philosophy is not exclusively occupied with epistemology and ethics; and psychology, though it may provide the data, does not professedly deal with those topics.

Such criticism aside—and Mr. Ritchie anticipates it by remarking that his opinion is advanced "at the risk of misunderstanding and unpopularity"—"The Natural History of Mind" is intentionally a suggestive rather than a constructively conclusive book. Nearly half of it is taken up by preliminary

chapters dealing, among other matters, with causation, the distinction between the living and the lifeless, the nervous system, and the functions of the brain. These preliminaries are necessary, for in the event much will turn upon the way they are treated. For example, the question of freedom (which, for Mr. Ritchie, rather than consciousness, is "the most central and illuminating fact of mental life") can only be profitably discussed in the light of an adequate theory of causality. Again, teleology (which "is not an explanation in the ordinary sense but a statement of fact, or a description") is one of those facts of which account must be taken when dealing with specific biological problems that are only generically covered by solutions of the more comprehensive problems of physics. Man, as a physical object in a physical world, is subject to physical laws; as a living organism, he is subject to biological laws as well; and, as a being capable of perceiving, thinking, feeling and willing humanly, it is surely arguable that even more specific laws apply also in his case. As Mr. Ritchie points out, you can prove once for all that all triangles have certain common properties; but this does not absolve you from considering the peculiar properties of the different kinds of triangles.

Very interesting chapters are those on the brain and nervous system. They show how modern work has overthrown the reflex theory of Descartes that for so long handicapped physiology and psychology alike, and also indicate incidentally the influence of the *Gestalt* way of thinking. Their results for psychology are, however, in the main negative. The answer to the question "What does psychology study?" which stands as title to Chapter vi, is disappointing. The science has no source of information of its own not shared by other sciences; and it differs from these chiefly if not only by reason of the explanatory concepts of which it makes use. Mr. Ritchie writes paradoxically: "Self consciousness is a fact but not a fact that leads to knowledge about the self or the consciousness". Yet, if psychology is "the study of the embodied mind", surely this peculiar fact must lead to knowledge of some sort, that the self at least knows itself capable of feeling, thinking, willing and the like, because it has experienced itself doing so. This is no knowledge of abstract 'activities', but of an active concrete entity, from which the anthropomorphic conceptions used in physiology and the biological sciences are derived. It is noteworthy that Mr. Ritchie admits in parenthesis: "We need not enquire at present whether the categories of cause and substance even are safe from this accusation" (of anthropomorphism).

The final chapters deal with sensation, perception and cognition, and with emotion and thought, the latter containing a sympathetic criticism of Spearman's Two-Factor Theory and Principles of Cognition mainly from the point of view of linguistic defects in verbal *g* tests.

It has been said that this book is suggestive. It gives evidence of very wide reading in very many subjects; and, while necessarily dealing with profound problems, is written with an admirable lightness of touch.

Clinical Research

Vascular Disorders of the Limbs: described for Practitioners and Students. By Sir Thomas Lewis. (Department of Clinical Research: University College Hospital, London.) Pp. xi+111. (London: Macmillan and Co., Ltd., 1936.) 6*s*. 6*d*. net.

THE active department of clinical research, under the direction of Sir Thomas Lewis at University College Hospital, London, has been engaged for the last eight or nine years in the study of disturbances of the circulation in the limbs. Because of their much greater surface relative to that of the head and trunk, the limbs suffer more from alterations in blood supply, and the circulation in the limbs is of greater importance. This book is not, however, an account of the scientific discoveries which have been made, but is written as a guide to the practitioner to direct his treatment of different conditions.

Many interesting observations are made. It has been customary to treat deficient circulation in one limb by keeping it warm; Sir Thomas Lewis points out that a greater increase in circulation is obtained in the limb by warming the rest of the body. Heat applied to the body as a whole has the effect of lessening the vasoconstrictor tone in all arteries; the arteries, therefore, dilate and admit more blood to the extremities.

A valuable analysis of the conditions grouped under the heading of Raynaud's disease is given; Sir Thomas Lewis states that the term has been applied to a number of distinct conditions; he applies the term Raynaud's *phenomenon* "to any state in which loss of circulation to digits occurs spasmodically, displaying itself in transient attacks

of discoloration"; he uses Raynaud's *disease* to comprise cases of intermittent spasm of digital arteries. The cause of the disease is that the arteries are incapable of full expansion, being narrowed by thickening of the intima. In treatment, vasodilator substances have little or no value, though if the basal metabolism is low, the administration of thyroid is often beneficial. The section and degeneration of the sympathetic nerve supply improves the circulation to the limbs in these cases.

During the period in which the research on which this book is based has been done, Sir Thomas Lewis has been an influential advocate of the importance of clinical as opposed to laboratory investigation in the fight against disease; his book is, therefore, to be regarded as an example of what clinical research can do for the patient. That the results embody a large amount of industrious and expert observation is obvious, but they are rarely surprising, and it may be asked whether the most valuable and inspired research does not always give surprising results.

Clinical research is of course of the highest importance, for only by contact with it does the clinician learn the importance of physiology; the neglect of clinical research is responsible for the inefficient therapeutics seen everywhere to-day. But clinical methods are too limited to allow fundamental discoveries to be made; these demand the freedom which is only possible in the laboratory. If the laboratories have not been sufficiently fruitful in the past, it is the fault of the men in them, and their lack of training, rather than of the possibilities of laboratory methods.

The Biological Action of Radiation

Biological Effects of Radiation: Mechanism and Measurement of Radiation, Applications in Biology, Photochemical Reactions, Effects of Radiant Energy on Organisms and Organic Products. (Prepared under the auspices of the Committee on Radiation, Division of Biology and Agriculture, National Research Council, Washington.) Edited by Prof. Benjamin M. Duggar, with the co-operation of Janet Howell Clark, Kenneth S. Cole, Farrington Daniels, Gioacchino Failla, Charles Packard, Henry W. Popp. Vol. 1. Pp. x+676. Vol. 2. Pp. vii+677–1343. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 70*s*.

TO write a comprehensive work upon the "Biological Effects of Radiation" has now become an impossible task for any single person, and we are, therefore, especially grateful to Prof. Duggar and his collaborators for the preparation of the two volumes before us. These volumes contain forty-three essays on various aspects of the question, and give about four thousand references to original papers; while their scope ranges from pure physics and chemistry to the chromosomal aberrations which may be produced by irradiation. Two subjects are, however, specifically excluded, namely, practical considerations relating to plant production, and those special applications of rays which are concerned with radiotherapy. It is as obviously impossible for one person to write an adequate review of such a work as this, as it is for him to compile it; and all that can be attempted is to give a general idea of the vast field that has been covered.

The great difficulty encountered by all serious workers upon experimental radiology is the highly varied branches of science with which it is necessary for them to have some acquaintance. As a consequence of this, we think that the writers of these volumes have done well in their introductory chapters to lay stress upon recent developments in physics, physical measurements, and some of the general chemical effects of radiations. To the pure physicist, the introductory chapters on photons, electrons and measurements might seem elementary or even superfluous; to the biological worker we are certain that they will prove invaluable. A further complication is introduced by the fact that rays of various kinds have now become not only an object, but also a means of research.

Mutations in plants and animals have been effected by exposure to X-rays and to the rays from radium; these subjects are dealt with in a series of papers which are at once clear, succinct and comprehensive; and although any special reference to the therapeutic use of radiation is excluded, the practical bearing of this experimental work must be obvious. The science of genetics is indeed largely indebted to the use of radiations for the attainment of some of its most interesting results.

To make definite selections from the large amount of information which has been presented to us is difficult, but there are a few topics, apart from those that have already been collectively mentioned, which it may be interesting to name, so that workers in special fields may have a guide as to where an epitome of the latest information is available.

The first of these is an excellent paper on the statistical treatment of biological problems in irradiation. The need for adequate statistical presentation of the experimental data obtained from large numbers of animal experiments is obvious, and more especially is this the case when a large number of experiments have been made on, for example, the question of heredity and susceptibility to implanted tumours. Too often conclusions on these and similar subjects have been based, not only on inadequate data, but even have been reached by methods which no statistician would regard as admissible. The essay on this subject should therefore fulfil a requirement which has long been unsatisfied. Of other aspects which may fittingly be made the subject of special mention are the biological effects of 'short' electric waves, which are of particular interest at the present time owing to the extensive use that is being made of them in medicine, and the much discussed problems of mitogenetic radiation. The radiations considered range from the 'short' electric waves to the γ-rays of radioactive substances; while the biological field extends from bacteria to phanerogams and from protozoa to mammalia.

The two volumes must undoubtedly find a place in every laboratory and institution where the biological effects of radiation are the subject of instruction or investigation.

India and Mineral Development

India's Mineral Wealth:
a Guide to the Occurrences and Economics of the Useful Minerals of the Indian Empire. By Dr. J. Coggin Brown. Pp. x+335+14 plates. (London: Oxford University Press, 1936.) 15*s*. net.

THE predominant impression produced by a perusal of this handy little book is one of astonishment at the amount of information packed within so small a compass. Dr. Coggin Brown possesses the happy facility of condensing facts and preserving at the same time, even in a work of this kind, an easy style and a connected narrative. The bird's-eye view of the situation, occupying no more than a single page of the introduction, is a snapshot as complete as it is harmonious of the position of mineral development in the Indian Empire, in which is included Burma.

The introduction serves as a signpost to anyone desirous of following the progress of the country from the point of view of minerals. It reminds readers where they can consult reviews of mineral production, including brief accounts of the geology pertaining to each mineral and full bibliographical lists. The mineral and geological literature concerning India is probably the best indexed in the world, thanks to the publications of her Geological Survey and more especially to the unselfish labours of Mr. T. D. LaTouche. The construction of a work of reference is a monotonous and glory-lacking occupation, too apt to be received, like food and drink, as a matter of course, and sharply criticized for any omission or defect rather than lauded for its incontrovertible value. Those who have occasion to use such works as the indexes of LaTouche and the compendium now under review will feel inclined to follow the example of the Cambridge divine who made a point of thanking God for the men who make dictionaries, catalogues and indexes.

Within a space of 300 pages of text, the useful minerals of India are considered individually by Dr. Brown as regards occurrence, history of development, uses (in the case of some of the less common minerals), outputs and their values from early times to the present day, and comparison with imported rivals, with brief notes on their origin.

India and Burma are associated in the average lay mind with gold and precious stones, but it is with the fuels that the author very rightly commences. Apart from the pivotal importance of fuel for most industrial purposes, India's output of coal and oil greatly exceeds that of any other mineral. As the figures published in this book show, during the quinquennium ending in 1933, the value of the output of the Indian goldfields, which supply the world with about 1·34 per cent of its needs in gold, was about three tenths of the value of her coal, and less than two fifths that of her petroleum; as for precious stones, the coal production was worth nearly 450 times as much as the diamonds, rubies, sapphires and spinels together! The book is full of little suggestive side-issues and remarks on subjects such as the simultaneous import and export of paraffin wax; the recovery of gasolene from petroleum gas, and the potential uses of what remains in the manufacture of dyestuffs, solvents and anæsthetics, in the preparation of helium for aeronautics, and as a fuel for domestic and power purposes; the amount of silver leaving the country in the copper matte and the zinc concentrates; the failure of corundum mining in contrast to its success in South Africa;

the import of coal for consumption on the Giridih coalfield and the analogous importation of Persian oil for fuel purposes in the Yenangyaung oilfield of Burma.

To check every statement and figure would be to rewrite the book, but those who know Dr. Coggin Brown's reputation for accuracy will have complete confidence in accepting his statistics. As Superintendent of the Burma Party of the Geological Survey of India for many years, as Mineral Advisor to the Indian Trade Commissioner, as an officer closely associated with the Imperial Mineral Resources Bureau, and as a man with an undoubted *flair* for collecting and presenting statistical information, Dr. Brown is peculiarly qualified for the task he has so ably completed. The work closes with a bibliography which with business-like brevity includes only the latest and most comprehensive publications dealing with each mineral.

It would take an ultra-cynical mind to discover any positive defect in Dr. Coggin Brown's excellent little book, and one closes it with one regret only, and that is that its pages are so few. To increase them to any large extent would, admittedly, defeat the main purpose of the volume, but one suggestion is perhaps worthy of consideration with respect to a second edition. It is the addition of a few pages describing and commenting on the special problems which confront the adequate development of India's minerals. As examples, the following will serve: the vital necessity of persuading the Indian peasant not to cook his food with cow-dung, the selling price of which as a fuel is half its value as a manure, but to substitute coke or coal, and to increase in this way and for this worthy purpose the ridiculously low coal-consumption figure of two million tons annually by a population of more than 352 millions; the reduction thereby of the considerable imports of artificial manure; the conservation of indigenous coking coal for metallurgical requirements; the possibility of eliminating the high sulphur content from the Assam coal, which would then furnish a rich source of hard, metallurgical coke; the substitution of some other reducing agent in the place of metallurgical coke; the question of winning oil by mining in place of boring; the prospects of oil shale and artificial substitutes as rivals to the free mineral; the adequate utilization of the large gas supplies available in the country; the question of India's smelting her own zinc concentrates, copper matte, tin ore, chromite, nickel and cobalt, speiss, etc., instead of exporting them in the raw state; the problem of utilizing more of her pig iron in the manufacture of her own steel; the discovery of additional uses for the almost inexhaustible supplies of magnesite, and for the large quantities of monazite; the establishment of a sulphuric acid industry; the employment of water-power for the manufacture of aluminium from the large reserves of bauxite; the encouragement of glass manufacture to replace the enormous imports from Japan; the remedy for the rock-bursts which at depths of 1½ miles are becoming a serious impediment to further development of the gold mines.

Many of these and other problems are alluded to directly or indirectly in the text but, having in mind the number of Indian statesmen, legislators, administrators and industrialists who will find a use for the book, a definite tabulation and presentation of the problems might stimulate and direct research, and even legislature. The book purports to be a collection of facts, but the problems are also facts though their several solutions have unfortunately not yet attained that status. The suggestion is no criticism of what is in the book; what is already there is so excellent that it is excusable to want more, even if only another ten or a dozen pages.

The book will be invaluable to industrialists, Government officials, economists, statisticians, members of legislative assemblies, and all interested in a great country which, with a mineral output valued in 1928 at £24 million, is slowly taking her place in the mineral world but still has much further to go.

EDWIN H. PASCOE.

Malayan Zoogeography

Die Geschichte des Sundabogens: eine tiergeographische Untersuchung. Von Bernhard Rensch. Pp. viii+318. (Berlin: Gebrüder Borntraeger, 1936.) 18 gold marks.

IN the present volume Dr. Rensch presents a masterly summary of the zoogeography of the Malayan Archipelago. A general account of the expedition he and his colleagues made to the Sunda region (islands east of Java) was published in 1930, and the author has now collected together not only the results of his own expedition but also of some three hundred titles dealing with the region as a whole.

The bulk of the book consists of a detailed analysis of the fauna of each island in turn. Generally speaking, only the mammals, birds, reptiles, amphibia, butterflies and land snails are

dealt with, but these are probably sufficiently representative of the various types of dispersal-power in the animal kingdom. His method has been to make a list of the fauna of the whole region and to divide the species, genera, etc., into four groups: those with a predominantly western (Asiatic) distribution, those with an intermediate type of distribution, those with an eastern one, and those with a distribution of an 'indifferent' type. The frequency of the types on each island is then examined and other resemblances between the fauna of different islands or groups of islands are investigated.

A preliminary conclusion is to maintain the significance of 'Wallace's Line', running between the islands of Bali and Lombok. This line is not, as indeed Wallace admitted, a boundary between two distinct faunal regions. It is rather the western limit of many animals with an eastern type of distribution. Thus in Bali, amongst the 255 genera, the four types of distribution are in the proportions 128 : 3 : 5 : 115, while in Lombok the proportions are 70 : 5 : 10 : 117 (out of 202 genera). From Lombok eastwards, there is a gradual but regular increase in the number of eastern forms. A more general conclusion is that the islands west of Lombok form part of the Asiatic continental shelf, while New Guinea, etc., belong to the Australian shelf; between these areas lies a *labile* area where the relations of land and sea have long been unstable. The fauna of this unstable area is fundamentally Asiatic in origin, but in relatively recent times it has been invaded from the east. Forms with better developed powers of dispersal (birds and butterflies) tend to penetrate westwards more than less mobile forms (reptiles). Dr. Rensch considers (p. 298) that the facts in general support Wegener's application of his theory of continental drift to this region, though he would modify such details as the dates of separation very considerably.

Apart from the special study of the Malayan region, several points of the widest zoogeographical interest are raised. Thus the author considers what is known of the repopulation of Krakatau after the earthquake of 1883. This is used to show that birds, small snails, and small reptiles have a considerable advantage in dispersal over mammals, amphibia and larger snails and reptiles. Mere lack of power of flight is not necessarily a barrier. Again, he notes the frequency with which a few miles of sea appears to act as a barrier to bird species. He suggests that in these tropical conditions there is never a yearly shortage of food and that no species has any urge to leave its normal habitat.

In all zoogeographical speculation, one feels strongly the need for some independent line of evidence to support the theories. A sufficiently complex series of hypothetical land-bridges and inundations could explain all the known facts of distribution without being true. Supplementary evidence derived from fossils is probably by far the best type of support, but unfortunately such evidence is at present lacking in the Malayan region. In some cases, however, Dr. Rensch's suggested bridges and dates have been independently postulated by geographers.

The fauna of many of the islands is still, of course, imperfectly known, and Dr. Rensch indicates (p. 301) which are especially deserving of exploration. It may be suggested that one larger map on which all the islands mentioned were clearly marked would have been a very useful addition to the book.

O. W. R.

Plant Cytology

Die Pflanzenzelle

Vorlesungen über normale und pathologische Zytomorphologie und Zytogenese. Von Ernst Küster. Pp. xii + 672. (Jena: Gustav Fischer, 1935.) 34 gold marks.

THIS book embodies the main features in Prof. Küster's courses of instruction in plant cytology at Giessen as they have developed during the last fifteen years or so. It is therefore particularly interesting as reflecting the point of view of a school of botany from which a very definite individual contribution has been forthcoming during the period in question; at the same time, the book shows that the author has been at pains to keep abreast of modern views in a field where output of publications, of new terminology and of new theories has been at a maximum, though the progress of time may show that the actual addition of new facts has been proceeding rather more slowly.

Prof. Küster has himself been a pioneer in the study of pathological plant anatomy, and this experience gives a definite character to the book, in which anomalous behaviour of cells and both degeneration and regeneration phenomena are treated with unusual thoroughness, though at the same time with a welcome breadth of outlook.

The book is also a notable departure from most recent cytological texts in that almost equal space is given to the four sections upon protoplasma, the nucleus, the wall and cell development, whilst three rather less extensive sections deal respectively with plastids, with starch grains, crystals and other dead inclusions, and with vacuoles. Thus much less space is given to nuclear division phenomena than usual, whilst the chondriome and vacuome receive subordinate, if sympathetic treatment, in the sections that deal with plastids and the vacuole. The treatment throughout is balanced and critical, and when an extensive section of modern literature is dealt with rather summarily, as is the case with the mitogenetic hypotheses of Gurwitsch, the author briefly indicates the ground for his position.

Altogether, whilst probably no other plant cytologist would write a book with the same emphasis, that is obviously one of the reasons why the book should be welcomed by botanists generally, who will probably read it with profit, and notably such sections as the extensive one dealing with the contribution to our knowledge made by plasmolytic studies, where the author's own investigations give additional weight to the critical presentation of results. The full bibliographies to each section, including citations of papers published in 1935, add very considerably to the value of the work.

Nature and Functions of Soil Humus

Humus :
Origin, Chemical Composition, and Importance in Nature. By Prof. Selman W. Waksman. Pp. xi+494. (London : Baillière, Tindall and Cox, 1936.) 30*s*.

NO problems of soil science have proved more difficult than those concerning the nature and functions of soil humus. The early work of Sprengel and Berzelius yielded a long list of humic and other acids which are still discussed in textbooks and some scientific papers, even though it has long been shown that they are indefinite complexes greatly modified by the processes of extraction. Physical chemistry and microbiology have cleared up some of the problems involved in the acidity of peats and soils and in the decomposition of plant residues, but methods are still lacking for characterizing adequately the forms of humus in different types of soil.

The fundamental paradox is that, in the soil, cellulose is rapidly decomposed and humus is comparatively stable, whereas in the laboratory humus is readily oxidized under conditions in which cellulose is inert. It is now obvious that most of the steps in the decomposition of plant residues are effected by micro-organisms, and that the more stable products are colloidal complexes formed by the condensation of modified lignins from plants with protein degradation products from micro-organisms. Little progress has yet been made in unravelling the constitution of these complexes. In the past, loose analogies were too often drawn between the humus extracts from soils and the black messes so readily produced in a variety of organic syntheses.

Agricultural investigations have brought out a bewildering array of special circumstances in which soil fertility appears to be related to the amount and form of soil organic matter or in which farmyard manure remedies some defect. Thus, the steady decline in yield in fifty years of continuous cereals at Woburn (not at Rothamsted as given by Waksman on p. 199) was associated with a loss of one third of the carbon and nitrogen originally present in the surface soil. Soil drift in the Canadian prairies and erosion in many parts of the tropics are the results of systems of land management which destroy soil organic matter by cutting off the normal additions and intensifying through cultivation the losses by oxidation. Farmyard manure and crop residues return to the soil the major plant foods, a variety of 'minor nutrient elements', and decomposible organic matter which forms colloidal complexes with high absorptive power.

The processes of soil formation are so intimately linked with the growth of plants and the decomposition of their residues that the main subject matter of pedology might well be regarded as the ecology of humus. Already in forestry it is recognized that the natural humus type should determine the system of management, and it is almost certainly true that the proper husbanding of soil organic matter is the essential requirement for any stable system of agriculture.

The literature on soil humus is immense in volume and widely scattered, but much of it is poor in quality. A critical review to replace Wollny's book of 1897 was long overdue, and Prof. Waksman's monograph will be warmly welcomed by workers in agriculture and forestry and in the many pure sciences which bear on soil problems. It contains a bibliography of well over

1,300 papers, and a particularly useful historical summary which shows how confusion has arisen through the uncritical use of ideas, nomenclature and methods long after they had lost their scientific basis. The statement of recent work on the decomposition of plant products under experimental conditions should prepare the way for a much more cautious and systematic approach to the more difficult problems presented by the behaviour of plant residues in natural and cultivated soils. It is to be hoped that the book will reach such a wide audience that there will soon be an opportunity for a second edition at a greatly reduced price.

Dairy Science

The Chemistry of Milk

By Dr. W. L. Davies. (Monographs on Applied Chemistry, Vol. 10.) Pp. xii+522. (London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

THIS book has been awaited with considerable interest by chemists and others working in a field much wider than that of milk production only. The extent of the interest is, indeed, a measure of the economic importance to-day of milk, not only as a substance for consumption more or less unmodified, but also as a raw material both for food products and in industrial processes.

It is perhaps not surprising that the literature of milk is vast. One would think it was the most important fluid in the world, to man as well as to the cow. It is a matter for some reflection that the literature of human blood, obviously the most important fluid to the human species, though wide and varied, is far less extensive than that of cow's milk.

Dr. Davies has wisely restricted the scope of his volume, which touches on bacteriological questions only quite incidentally. The book is what its title denotes, but it is more than a re-hash or a reconstruction of any previously existing book on dairy chemistry. The late H. Droop Richmond's invaluable volume may not be replaced by the newcomer, for it will always have great historical interest and a peculiar value owing to the fact that it was primarily the work of an analytical chemist, but the passage of time must necessarily give such a book more and more of a documentary and less and less of a practical value. Dr. Davies has taken the opportunity of bringing up to date all the literature surveyed in Droop Richmond's book, a process of deletion as well as of addition, and in so doing has entirely re-arranged the subject.

Part 1 of the book under notice discusses the composition of milk with particular relation to variations in composition and the causes thereof. Part 2 discusses each of the individual constituents of milk, from the type substances, butter-fat, lactose and casein, down to the 'minor' constituents, minerals, enzymes, vitamins and so on. Part 3 is devoted to the physical chemistry of milk, with a chapter on its coagulation, and Part 4 to the chemistry of milk processing, including particularly the technology of condensing and drying milk. Part 5 is, perhaps, not strictly speaking covered by the title of Dr. Davies's book, for it discusses the nutritive value of milk, both of its separate constituents and of milk as a whole. One can dismiss the possible irrelevancy of this inclusion in a book on chemistry, because of the importance of the subject and the interest of the survey.

Some minor criticisms may be permitted, such as the overlooking in Chapter viii of Bleyer and Kallman's work on the residual nitrogen of milk, although their work on lactochrome is mentioned. On the other hand, there is no reference to lactoflavin, the composition and synthesis of which have now been worked out, though they possibly had not been when Dr. Davies's manuscript was completed. Nevertheless, the position of flavin as an essential part of the vitamin B_2 complex was surely known at that time, and whey was its chief source.

One could, of course, make minor criticisms on many other points, especially on those where matters of opinion are involved. But surely Dr. Davies cannot maintain that commercial caseins should have a moisture below eight per cent; by far the greater portion of them have moistures between ten and twelve per cent, and generally nearer the higher figure. Dr. Davies does not, in my opinion, sufficiently stress the different properties of acid casein and rennet casein from the industrial point of view, and it is not made clear that they are quite uninterchangeable between the plastics industry and the adhesives industry (using this term in the widest sense). His figures for the moisture content of milk, whether spray dried or roller dried, are a long way out. Reasonable maximum figures for a good grade commercial full cream dried milk are 2·5 and 3·5 per cent respectively for the two types. Again, why does Dr. Davies state that "the conception of the analyst is that milk of low quality should not be offered

for sale, such milk as an article of food being equivalent to adulterated milk" ? The view of the analyst—presumably Dr. Davies means the 'public' analyst—is that milk must conform to legal requirements, and Dr. Davies himself points out that legal requirements do not prevent the sale of milk of low quality, provided it is 'genuine', that is, comes uncontaminated from the cow.

The range of subjects mentioned in the course of the book is far larger than might be expected by those who only casually come into contact with the chemistry of milk and its constituents. Taking a few isolated random pieces of information, one may record the distinction between 'casein' and 'para-casein'; the analysis of the milk of the zebra, the llama and the porpoise, among other mammals ; the methods of estimating citric acid ; the nature of autoxidative changes in fats, and so on. Indeed, one of the weaknesses of Dr. Davies's book is that he has crowded into it so much recorded information that he has left himself no time or space to evaluate it critically, and much of it badly needs this evaluation. The many detailed bibliographies at the end of each chapter, however, enable the reader to turn to the original sources and make this evaluation for himself. The book is made still more useful by an alphabetical author index before the subject index at the end.

This book is so important, and must so soon go into another edition, that the reviewer feels, in all friendliness, obliged to urge upon Dr. Davies and the publishers to make a new edition the occasion for careful revision. There is evidence of inefficient proof reading. Some of the undetected errors are trivial, but one can scarcely pass over the description, on p. 96, of β-lactose as "β-glucose-β-glucoside". Again, on the next page, it is stated that Hockett and Hudson's new compound constituted "the first instance for lactose to crystallise out in the anhydrous form". The statement should have been made to apply, of course, to α-lactose only, since β-lactose always crystallizes without water of crystallization.

It has, moreover, to be admitted that Dr. Davies possesses an unfortunate and rather inelegant style. This is shown in, for example, his definition of iodine value as "the percentage of iodine with which the unsaturated acids of the fat can combine". One sees what Dr. Davies means, but he has not said it. There is a sentence towards the end of p. 80 that is, at any rate to the reviewer, almost meaningless, and this is not the only example.

The fact remains that Dr. Davies's compilation is very valuable, and would be invaluable were it readable, which in places it is not, owing to his curious handling of the English language. In a sincere wish to increase the value of this book to workers in many branches of science and technology, and in the desire to assist Dr. Davies in maintaining the high reputation that is already rightly his in the research field, I would urge upon him to enlist the assistance of some of his colleagues at Reading for a thorough revision of this book on the literary side.

A. L. Bacharach.

The Field of Inorganic Chemistry

Inorganic Chemistry

By Niels Bjerrum. Translated from the third Danish edition (1932) and brought up to date and adapted to English conditions in collaboration with the author by R. P. Bell. Pp. x+317. (London : William Heinemann, Ltd., 1936.) 7*s.* 6*d.*

IT is seldom that any real enthusiasm can be aroused by an introductory chemical text-book. After the novelty of the 'ultra-humanized' book, introduced a decade or more ago, had worn off, there appeared imitations with varying degrees of merit, and differing mainly in the order of presentation of conventional matter, just as previous to them a line of monotonous uninspired productions had challenged the keenness of generations of beginners. Prof. Bjerrum's volume does not essay to initiate a further revolution ; it strives after no sensational effects, but unostentatiously and by a masterly treatment of its subject matter embodies all the qualities of a really first-class text-book. For its modest size, its special strength is in its handling of physical and theoretical aspects and developments. There are few who would fail to endorse the opinions expressed in the foreword by Prof. Donnan, who states that it is the finest introduction to modern chemical science that he has read, that there is no fundamental aspect of that vast field as it exists to-day that the book does not explain and illustrate in a clear and logical manner, and that its adoption in every English-speaking seat of learning would result in a marked improvement in the average standard of chemical knowledge.

After a short introductory chapter, the atomic theory with its practical aspects and ramifications

is treated in the widest sense, embracing solutions, crystals, kinetics and valency. The non-metals are then dealt with in natural groups; a special feature, however, is that each group is followed by an adequate section on chemical change, each section being the one most suitably illustrated from the element-group preceding it. Thus hydrogen is followed by velocity and equilibrium in the formation of water, the halogens by velocity of chemical reaction, the sulphur group by a comprehensive survey of the modern theory of acids, bases, ionization and reactions in solution, the nitrogen group by the laws of chemical equilibrium, and the carbon group by thermochemistry and fuels. Then come the light metals with radium and radioactivity, the periodic system, atomic structure and electrochemical series; lastly, we have the commoner heavy metals in their appropriate groups. With copper and silver are considered the complex compounds and the general theory of complex ions, electrovalency and the nature of chemical linkage.

Practical aspects and applications of chemistry are interwoven throughout the whole text. It would perhaps be hypercritical to complain that there are no photographs and only seventeen line diagrams, including graphical plottings, and that deuterium is no more than mentioned and nothing is said about heavy water.

As a result of the inclusion of far more detailed physical chemistry than is found except in a large treatise or special text-book, we have a most up-to-date and useful survey of that branch of the science; the section on the modern theory of electrolytes is particularly worthy of note, covering as it does about forty-five pages and being work with which the author and his collaborators of the Danish school of physical chemistry are so closely associated. The book should be a source of inspiration to the post-novitiate student and one of interest and instruction to the more hardened scientific veteran. Binding, printing and production are in keeping with the high standard of the text. N. M. B.

Structure Factor and Electron Density Formulæ

Simplified Structure Factor and Electron Density Formulæ for the 230 Space Groups of Mathematical Crystallography

By Dr. Kathleen Lonsdale. (Published for the Royal Institution.) Pp. vii+181. (London: G. Bell and Sons, Ltd., 1936.) 10*s*. net.

THE intensity of an X-ray crystal reflection is governed by many factors, such as the state of perfection of the specimen and the electronic structure of the component atoms, but chiefly by the relative arrangement of the atoms in the unit cell. The resultant amplitude obtained by combining simple sine waves emanating from each atom in the structure is known as the geometrical structure amplitude. Dr. K. Lonsdale has carried this summation over the co-ordinates of the general positions in which the atoms lie ("equivalent points") for each of the 230 space groups of mathematical crystallography. The general formulæ she has already given in the "International Tables for the Determination of Crystal Structures" (see NATURE, 137, 927; 1936), but in the present work these equations are reduced to forms in which they can be applied directly for any given combination of indices. In addition, the converse formulæ, in which the electron density at any point is expressed as a Fourier series, are given in convenient form, the summation here being taken over the eight quadrants of the reciprocal lattice, so that only positive values of the indices *hkl* need be considered, if the axes are orthogonal. For non-centrosymmetrical structures, the way in which the phase constants vary in the different quadrants is also given in every case.

We must congratulate the author on the completion of this intricate and beautiful piece of work. It will prove of inestimable value to all those engaged in quantitative X-ray analysis of the solid state, and its necessity will become more and more apparent as the methods of investigation improve and it becomes possible to make more rapid comparisons between one structure and another often belonging to an entirely different space group. The task of deriving these complicated relations from first principles each time soon becomes a serious handicap. Attention should be paid, however, to the warning given by the author as to the necessity of understanding the basis of the calculations before attempting to apply the tables in special cases.

The photographic method of reproduction from the original manuscript ensures freedom from misprints, and has the further welcome result of making the price very moderate for a work of this nature. We envy Mrs. Lonsdale her ability to produce such a manuscript, that all can read!

J. M. ROBERTSON.

A Programme for Astrophysics

Theoretical Astrophysics :
Atomic Theory and the Analysis of Stellar Atmospheres and Envelopes. By S. Rosseland. (International Series of Monographs on Physics.) Pp. xix + 355. (Oxford : Clarendon Press ; London : Oxford University Press, 1936.) 25*s*. net.

THE author of this book is well known as the professor of astronomy in the University of Oslo. It is evident that the same broad outlook upon the future of his science that led him to found the Institute of Theoretical Astrophysics at Oslo, with its associated publication *Astrophysica Norvegica*, has inspired him also in planning this volume.

The first few chapters give a logically developed account of atomic theory, treated by wave mechanics approached from classical dynamics via statistical mechanics. It is taken as far as the theory of atomic multiplets, and followed by a short account of the quantum theory of radiation. So it provides in outline a necessary and sufficient basis in general physics for almost all the astrophysical theory which follows.

The central part of the book is naturally devoted to the theory of stellar atmospheres. Starting from the theory of propagation of radiation in an atmosphere, and the formation of the continuous spectrum, it passes on to the treatment of line-widths and total intensities. A special feature is the account taken from the outset of the possibility of cyclical atomic transitions between more than two quantum states. Prof. Rosseland was himself the first to realize their significance in his well-known theory of bright lines in stellar spectra, and they have lately gained new importance in regard to the troublesome question of the central intensities of absorption lines. This theory is then linked on to that of thermal excitation and ionization in stellar atmospheres, which is specially associated with the names of Saha, Fowler, and Milne. By giving a simple unified rational interpretation of the whole sequence of stellar spectra, it probably still ranks as the most remarkable success in the application of atomic physics to astronomical observations. The effects of rotation, and of electric and magnetic fields, on the form of stellar lines are next considered. The occurrence of molecular bands in the spectra is also thoroughly discussed.

The last part of the book deals with the theory of stellar material lying outside the normal atmospheres. It proceeds from a consideration of the solar chromosphere and corona to the extended envelopes of some giant stars, then to gaseous nebulæ, and finally to the cosmic cloud. These all present new problems of mechanical and radiative equilibrium, amongst the latter being various intensely interesting questions connected with the occurrence of 'forbidden' lines.

The author's method in tackling any problem is first to describe clearly the *general* physical theory and the *general* mathematical methods that are required. In dealing with applications, he is, in this book, more concerned with key ideas, and with a careful statement of the assumptions and restrictions that have been made, than with details of results. This treatment will make the book particularly valuable to anyone beginning research in astrophysics. In the first place, it will put him in a position to refer intelligently to works of reference on physical subjects of the type of Fowler's "Statistical Mechanics" or the "Handbuch der Physik". In the second place, it will enable him to read the most recent work on the branches of theoretical astrophysics here treated, with a clear understanding of what has led up to it, and of the technique employed. Also the book will be welcomed by mathematical physicists wishing to gain an adequate idea of this field of application of their work.

The book has one characteristic which some readers may judge to be a deficiency. The astrophysical applications are in many cases left off at a seemingly unsatisfactory stage, and not completed by working out detailed theoretical results suitable for crucial observational tests. But this is apparently done by design. For, in spite of the almost startling successes of the subject, surveyed in the masterly introduction to the present volume, there is probably no part of it that will not repay fresh investigation using more powerful mathematical methods or more general physical models. The hope that this will be done, no less than that fresh problems will be attacked, is evidently behind the prefatory remark : "The aim of this work is to formulate a programme of theoretical astrophysics. . . . A second volume is planned to give a similar view of the internal structure of the stars". Prof. Rosseland's attractive presentation of his programme should draw many recruits to the promising task of attempting it.

W. H. McC.

The Theory of Differential Equations

Introduction to the Theory of Linear Differential Equations
By E. G. C. Poole. Pp. viii+202. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 17*s.* 6*d.* net.

SINCE Newton and Leibniz began to study differential equations in the seventeenth century, mathematics has made great strides. Though the creative mathematicians have mainly been inspired by the art of their subject rather than by the prospect of its useful applications, yet the demands made by the rapid progress of science have been responsible for a considerable amount of research. Much of this has been devoted to differential equations, for herein lies primarily the mathematical basis of applied science, notably physics and engineering. Unfortunately, however, most practical equations cannot be solved in finite terms, so that resort has to be made to approximations. Even Newton himself realized this difficulty and tentatively applied power-series, but before such a method could be reliably applied, it was necessary to show, not only that the power-series was valid within specified boundary conditions, but also that a solution to the given equation actually existed. It was not, therefore, until Cauchy discriminated between analytic and non-analytic systems and gave rigorous existence theorems for each type that any material progress was made.

Of the many types of equation, that which occurs most frequently is the linear form and, as a consequence, much has been written on separate branches of the relevant theory. Dr. Poole's "Introduction", the preface of which forms the basis of the above sketch, deals with this type and incorporates a considerable amount of noteworthy research in a single volume. The text, running into ten chapters, may be divided roughly into two parts. The first part, consisting of the first five chapters, deals mainly with the properties common to most linear equations; the second part—Chapters vi–x—is devoted to detailed discussions of the well-known equations of Gauss, Laplace, Lamé and Mathieu.

Among the general properties may be specially mentioned the powerful operational calculus of Heaviside, with its important application to equations with constant coefficients, and also, the principle of invariant factors, so essential to the Fuchsian theory. In the chapter on equations with uniform analytic coefficients, the interchange of solutions around a circuit is well illustrated by Euler's homogeneous equation and the equivalent system of linearly independent solutions—the Hamburger set—derived from Jordan's canonical transformation. Thomé's inductive proof of Fuchs's condition for a regular singularity is also given, together with Birkhoff's direct proof of the sufficiency of the conditions. The final chapter of the section on general properties is concerned with regular singularities, and includes a rigorous treatment of formal solutions in power-series.

Chapters vi and vii begin the detailed examination of some particular equations and are devoted to the theory of Gauss's, or the hypergeometric, equation. The relation between this and Riemann's *P*-equation is clearly exhibited and the existence of Kummer's 24 series-solutions proved. The discussion then passes to Schwarz's problem and conformal representation. The special cases of the dihedral, the octahedral, the tetrahedral and the icosahedral equations are of particular interest. Chapter viii deals with Laplace's transformation of the generalized equation with constant coefficients. This includes the theory of Kummer's first and second confluent hypergeometric equations with integral representations of their solutions. Then follows, in Chapter ix, the derivation of Lamé's equation and the relevant theory introducing Weierstrassian elliptic functions, with Halphen's transformation and Brioschi's solutions. The chapter ends with a brief discussion of Picard's type of equation in which the coefficients are uniform doubly-periodic functions.

The final chapter gives an account of Mathieu's famous equation which arose in a problem on a vibrating elliptical membrane. The particular solutions, known as Mathieu functions, are soon introduced, but, owing to the difficulty of finding a solution to the general form, only the equation which arises in celestial mechanics is considered. The theory concludes with an account of the solution of Lindemann and Stieltjes, which is modelled on the Hermite-Broschi treatment of Lamé's equation.

The equations of Bessel and Legendre have not been discussed in detail, for, as the author points out, "there are so many admirable accounts of them in English suitable for students of every grade".

Each chapter contains a number of important and useful examples, many of which are additional theorems taken from original papers. A valuable bibliography is also provided for further reading.

The book is designed for senior undergraduates at Oxford, but it may be confidently recommended to every mathematician interested in the very important study of differential equations.

F. G. W. B.

The Growth of Ancient Science

Histoire des sciences : Antiquité

Par Pierre Brunet and Aldo Mieli. (Bibliothèque scientifique.) Pp. 1224. (Paris : Payot et Cie., 1935.) 200 francs.

THE history of science claims a legitimate place in the organization of research and learning on the ground that it gives a faithful account of the development of positive knowledge with reference to the intellectual atmosphere of the various periods of civilization. It is not merely as an outline of the progress of thought and technology, but rather as a critical exposition of the chequered career of scientific thought, that the history of science has now secured recognition as an important and useful branch of knowledge and study. Of this conception of the history of science, an excellent illustration is given by the present work, which covers the origin and growth of ancient science.

In spite of its comprehensive title, this work deals almost exclusively with classical antiquity, though three of the opening chapters (pp. 38–112) are devoted to those civilizations which are claimed to have a direct influence on Greek and Roman thought and technology. It may be said, however, that a mere juxtaposition of the Eastern civilizations with that of the Greeks does not illustrate sufficiently the influence of the former on the latter. It is true that we possess little direct evidence of the possible filiation of this influence. But there is no reason why a discrimination should be made in favour of the Egyptian and Assyro–Babylonian civilizations.

There have been numerous and sometimes prolonged contacts between Greece, on one hand, and Persia and India on the other ; consequently, it is only fair to discuss, on the evidence we possess, the probable influence on Greece of all those races and civilizations with which Hellenism came into contact. As a matter of fact, this should be one of the most important tasks of modern research in this field of study. The authors of this work recognize the importance of this task, and they propose to deal with it more fully in another volume. In a lengthy note on p. 330 they indicate that the influence of Persia and India on Greece is not so great as is sometimes thought ; and they believe that if much of what is said of the antiquity of Indian science is discounted, it will be found that Greece may have influenced Hindu thinkers much more than is commonly admitted. The importance of this question is such that what they have to say on the matter in their forthcoming volume will be awaited with keen interest.

Faithful to their method of adhering strictly to original documents, the authors give a rather short account of the Pythagorean School. Similar reasons led Prof. Loria to dismiss summarily, in his "Storia delle Mathematiche", the claims put forward in favour of the importance of Pythagorean mathematics. But Sir Thomas Heath felt himself justified in giving, in his "History of Greek Mathematics", nearly one hundred pages to Pythagorean theories, for the evaluation of which he also uses later writers such as Nicomachus, Iamblichus and Theon of Smyrna. The truth may lie somewhere between these two positions. Nevertheless, the natural philosophy at least of the Pythagoreans (p. 428) could have been treated more fully in the present work, by making a judicious use of the testimonies of Plato and Aristotle and of other writers.

Of the controversial questions about which a straightforward opinion of the authors is given, we may quote Aldo Mieli's view of the personality of Socrates, whom he considers to be the last of the Sophists, or rather, as he puts it, a "Sophiste manqué", afterwards idealized by his disciples (p. 200). Contrary to the general belief, Aldo Mieli thinks that the influence of Socrates on science is more destructive than anything else, because he diverted the attention of the mind from the study of external phenomena to introspective or moral considerations. Again, the authors maintain that the study of Plato belongs to literature and philosophy rather than to science, his views on various scientific subjects being more speculative than positive.

A more generous attitude is taken towards Aristotle, because of his empirical attitude of mind ; and though the physical doctrines of the Stagyrite have been long ago discarded by science, the spirit of his inquiries still remains a

fundamental characteristic of scientific research. Moreover, the results obtained by Aristotle in the field of biology are of the greatest importance in themselves as well as for the history of science. All these points are adequately developed by the authors, who do not seem to share the opinion expressed by Prof. F. Enriques in his work "Il Mondo Antico", where he accuses Aristotle of having suffered from an inferiority complex and from an exaggerated 'professorial' attitude of mind.

An important part of the present volume deals with the Golden Age of Greek science in the Alexandrine period. In the field of pure mathematics, Euclid, Archimedes and Apollonius are treated with the prominence they deserve. The study of the works of Archimedes is far from being complete, and the authors believe that much could be done by using the available Arab manuscripts. In a lengthy note on p. 387, they explain the meaning of the famous "Method" of Archimedes as involving the notion of "integral" and of "static moments" considered as proportions and not as products of a distance by a force. It is thus suggested that this Method, which was known in the Middle Ages, has influenced the conceptions of Cavalieri and the genesis of the calculus.

The astronomical views of Heraclides and Aristarchus, and their bearing on the heliocentric view of the universe, are summarized and contrasted with the doctrine of the homocentric spheres developed by Eudoxus. So also are the remarkable labours of Hipparchus, who improved the theory of the Epicycles and used trigonometrical methods in astronomy, and of Eratosthenes, the founder of scientific geography. A good account is given of Ctesibius, Philo and Heron, the most representative engineers of classical antiquity. Of the later astronomers, Ptolemy is given fifty pages, in which a summary of his works is followed by helpful appreciations and criticisms from the authors. Interesting additions to the traditional exposition of Ptolemy are the two chapters on optics and acoustics, in which an adequate account is given of the methods and views of the ancients concerning these important subjects. The exposition of Greek mathematics closes with an analysis of the writings of Nicomachus, Diophantus, Pappus and Proclus.

The development of ancient medicine is outlined with great skill and understanding in Chapters viii, xxix, xxxvi, xliv, xlv and liii. The Hippocratic writings, the Alexandrine physicians, the controversies about Celsus, the various schools of medical theory, the remarkable works of Galen and the decline of medicine during the Byzantine period, are considered in turn and illustrated with long extracts from the original texts. The pharmacological views of Dioscorides are treated in a separate chapter. Chemistry is given only one chapter, near the end of the present work ; in this connexion, an interesting passage is quoted from a "Lesson of Comarios to Cleopatra" about the fabrication of gold.

If the Romans made negligible contributions to pure science, their practical mind asserted itself in their interest for applied science. Agriculture and husbandry, engineering and public works, navigation and military science, geography and meteorology, biology and medicine, owe a great deal to the genius of the Romans. This debt is very ably outlined in the present work in the several chapters dealing with the development of these subjects during the Greco-Roman period. The architectural theories of Vitruvius, the encyclopædic work of Pliny, are thus discussed side by side with the geographical writings of Strabo, and the tidal hypotheses of Posidonius. After a brief mention of the encyclopædists of the beginnings of the Christian era, the authors bring us to the threshold of the Middle Ages.

The volume contains a mass of material of scientific, historical and controversial interest—so much, indeed, that there is a risk that the reader may have difficulty in following the thread of the story. The authors are at great pains, however, to explain carefully the various problems raised in the light of the available texts, and to discuss conflicting opinions about them in a wealth of footnotes. The views expressed are illustrated and supported by nearly three hundred textual quotations from more than eighty original sources ; and a number of passages have been translated by the authors themselves. A comprehensive index, two synchronical tables and a critical bibliography of twenty-five pages add to the practical and scholarly value of this important work.

THOMAS GREENWOOD.

Short Notices

Archæology and Anthropology

The Law and the Prophets

By H. Peake and H. J. Fleure. (The Corridors of Time, Vol. 9.) Pp. viii+188. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 5*s*. net.

In each succeeding volume of "The Corridors of Time", the authors have sought to epitomize the salient characters of a period, as well as mark the cultural advance recorded. In electing to close the series with "The Law and the Prophets", they indicate that they see the transition from archæology to history, not so much as a matter of written record, as the dawn of abstract thought and the initiation of a concept of godhead, which transcends the tribalized or local deity. This is a logical scheme, but in practice it is apt to leave ragged edges.

Broadly speaking, this volume covers the last millennium B.C., coinciding, however, more or less with the Iron Age, rather than with any absolute span in term of years. It opens with the rise of the Scyths, passes then to Assyria, China of the Chou Dynasty and the philosophers, India, where the racial problem is further discussed in the light of the last census report, the rise and fall of the Jewish kingdom, Persia, Greece and the rise of Greek philosophy, and the Iron Age of Italy, of Central Europe and finally of the British Isles. As the authors have been constrained by their plan to deal very briefly with a vast body of material, which in large part is historical, their method of treatment has been cramped, and they have been able to devote too little space to the archæological argument, in which, as is shown in the admirable, if brief, summary of the results of latest research in the British Isles, their power of acute and suggestive reasoning most frequently illuminates the evidence.

A welcome announcement states that a supplementary volume will deal with the processes of racial and social evolution of man in general terms.

Bitumen and Petroleum in Antiquity

By R. J. Forbes. Pp. vi+109. (Leiden: E. J. Brill, 1936.) 2 f.; 5*s*.

Knowledge of the technology of bitumen in antiquity has been considerably extended by the recent excavations at Ur and elsewhere in Mesopotamia. Mr. R. J. Forbes, though a technical expert and not an archæologist, has made a comprehensive survey of the archæological and literary sources for the use of bitumen in ancient times, and discusses fully the information relating to the character, sources and uses of the material to be derived from this evidence.

Although known and used from very early times, the importance of bitumen and oil in industry and commerce is a modern development, their place having been taken by pitch produced from wood from Roman times onward, except in the manufacture of 'Greek fire', of which the use, it was agreed among the nations in medieval times, was "too barbarous" for war. This oblivion, which became more or less complete in the Middle Ages, Mr. Forbes attributes to the fact that not only were the ancients impressed by the dangers of handling the material, but also the principal sources of supply lay outside the bounds of the Roman Empire in the eastern sector of the Fertile Crescent, and more especially on the eastern side of the Dead Sea and in Mesopotamia.

Mr. Forbes, on the whole, agrees with the view that the use of bitumen by the Egyptians in embalming is late and not so extensive as was once thought. At the same time, he points out that the importance attached by the Egyptians in Ptolemaic times to control of the area in Palestine in which it occurred, must be regarded as significant. His examination of the uses of bitumen in building construction in early Mesopotamia and at Mohenjo-daro will afford valuable guidance to field archæologists.

Biology

Rhododendrons and Azaleas:

their Origins, Cultivation and Development. By Clement Gray Bowers. Pp. xiv+549+40 plates. (New York: The Macmillan Co., 1936.) 42*s*. net.

As announced in the preface, this book is concerned with the practical use of rhododendrons and azaleas in North America and elsewhere. In England much valuable experience has already been gained with the genus, and made public by the Rhododendron Society and Rhododendron Association. Full use of this information has been made by Mr. Bowers and he is to be congratulated on having provided a very useful compendium on the genus, especially for American readers. His chapter on the behaviour of new introductions in America should be of special interest to growers in Great Britain, where diversities of climate are not nearly so great.

Inside the covers of the book are two highly decorative maps of that part of the Old World and of North America wherein rhododendrons are found, the numbers in red referring to the geographical regions mentioned in the text. It is a pity, however, that the distribution of the outlying species, *R. Lochæ*, in Queensland should have been omitted, the presence of this species on a remote mountain being of considerable phytogeographical interest.

The coloured illustrations are very poor and not worthy of the book. Indeed, they seem more suitable as designs for wallpaper-panels. The black-and-white figures, however, though crude, often give quite a good impression of the species, which may sometimes

be recognized by anyone who already knows them well. The few photographs are mainly of general views in gardens and are very well reproduced.

The large bibliography will be useful to most readers and is divided into (1) general references, (2) historical, (3) culture and propagation, (4) physiology, etc., (5) hybridization, etc., (6) pathology and insect pests. J. H.

Les conceptions modernes de l'hérédité

Par Prof. Maurice Caullery. (Bibliothèque de Philosophie scientifique.) Pp. 312. (Paris : Ernest Flammarion, 1935.) 15 francs.

THIS book gives a fairly adequate account of the physical basis of heredity and of the more conventional aspects of genetics. The general treatment is on the whole satisfactory, but scarcely original. Unfortunately, many of the more important modern advances are omitted. There is no discussion of auto- or allo-polyploidy, of the evolution of dominance, or of the gene-complex. The physiology of sex-determination, and the whole subject of genetic physiology, is also omitted. The treatment of cell-division is entirely out of date : no attempt is made to modify the older views of it in accord with the work of Bělař, Darlington and the modern school of cytologists. On the other hand, Stern's cytological proof of genetic crossing-over is explained in a helpful manner.

There is a somewhat inadequate index, from which all names of authors are omitted. The references are scattered throughout the book, at the foot of the pages on which they are quoted. This is an extremely inconvenient system ; they should be collected at the end, when they ought to form a useful bibliography. E. B. F.

Chemistry

A Text-Book of Organic Chemistry

By the late Dr. Julius Schmidt. English Edition by Dr. H. Gordon Rule. Third Edition, revised and extended. Pp. xxiv+865. (London and Edinburgh : Gurney and Jackson, 1936.) 25*s*. net.

THE appearance of a third English edition of Julius Schmidt's text-book bears witness to a steady demand for this work by advanced students of chemistry and biochemistry. This is not surprising, as the choice of comprehensive text-books of advanced organic chemistry in the English language is strictly limited. The work under notice deserves commendation as providing a coherent and well-documented background to the numerous monographs and series of lecture-notes with which the present-day student reading for honours in this expansive subject is hedged about. Although it has grown from 798 to 865 pages since 1926, this text still remains between two covers. This is a distinct merit ; for, as a modern Dean Swift might write, whoever can reduce two volumes of an advanced organic chemical text-book into one deserves better of the honours student than the whole race of Beilsteins and Richters put together.

The new edition is considerably in advance of the last German edition of 1929, as on account of the death of Prof. Schmidt in 1933 no later German issue has been made. Dr. Rule has added materially to the value of his English text by including accounts of recent advances in the biochemical zone of organic chemistry (polysaccharides, sterols, bile acids, vitamins, hormones, natural colouring matters, etc.) ; the physical zone, also, has received its share of attention through the treatment of such topics as recent work on the Beckmann transformation, dipole moments, and dissymmetric allene derivatives.

It may be suggested that a fuller reference to the subject of strainless rings would be of use. J. R.

Recent Advances in Organic Chemistry

By Prof. Alfred W. Stewart. Vol. 2. With the addition of Part 2, by Dr. Hugh Graham. Pp. xiv+519+2 plates. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1936.) 21*s*. net.

THE reissue of the sixth (1931) edition of Prof. Stewart's well-known work contains a new supplement of four chapters by Dr. Graham, dealing with the bile acids and sterols (28 pp.), the cardiac aglucones (vegetable heart poisons) (7 pp.), the hormones (23 pp.), and the vitamins (19 pp.). Separate name and subject indexes are provided for the supplement. Dr. Graham has given a judiciously selective account of the important advances in these fields of work, so that in its extended form the book will continue to render valuable service to advanced students and research workers in organic chemistry and biochemistry. That progress during the past few years in the common domain of these two regions of chemical science has outstripped the most sanguine anticipations of the last decade is a reflection which must occur forcibly to readers of this supplement, with its review of so many spectacular achievements.

Engineering

Dielectric Phenomena in High Voltage Cables

By Dr. D. M. Robinson. (Monographs on Electrical Engineering, Vol. 3.) Pp. xii+173. (London : Chapman and Hall, Ltd., 1936.) 15*s*. net.

THE economies effected by the use of very high voltages when transmitting electric power have led to its rapidly increasing adoption, but the higher the voltage the greater the number of breakdowns of the transmission cable. In electric supply an interruption of this nature is most serious, so expensive and elaborate tests in specially constructed laboratories are being carried out by cable manufacturers on the wrappings which surround the cables (the sheath).

In some cases the breakdown leaves a clean radial hole between conductor and sheath. In others, scorched and brittle papers are found particularly in the inner portions of the dielectric. Often they leave tree-like or fern-like patterns accompanied by dry patches where scarcely any free impregnating oil

remains. The early investigators were baffled by the complexity of these breakdowns and concentrated their attention on the losses which occurred during a life test of the cable. Mathematical methods which assume that the sheath is homogeneous and that there are no 'voids' in it are only of limited use. In the book under notice, Dr. Robinson shows that visual examination has succeeded where external electrical measurements have failed. The work was carried out in the Research Laboratories of Callender's Cable Co.

The Design of Reinforced Concrete Structures

By Prof. Dean Peabody, Jr. Pp. ix+457. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1936.) 20*s*. net.

THE wider aspects of design are dealt with in detail by Dean Peabody in his book "The Design of Reinforced Concrete Structures". Theory is introduced so far as is necessary to develop the methods of calculation employed and to elucidate the force systems dealt with in the course of his subject, which includes the practical design of slabs, rectangular and tee beams, columns, footings and retaining walls, statically indeterminate structures and concrete arches. The numerous illustrative problems which have been fully worked out will be of especial value to the student. J. A. C.

Miscellany

The Paradise of Fools :

being an Account, by a Member of the Party, of the Expedition which covered 6,300 Miles of the Libyan Desert by Motor-Car in 1935. By Michael H. Mason. Pp. 282+23 plates. (London : Hodder and Stoughton, Ltd., 1936.) 15*s*. net.

ALTHOUGH this expedition into the Libyan desert, with Mr. Kennedy Shaw as leader, undertook scientific investigations, its primary function was exploration ; and to the author of "The Paradise of Fools", in which it is described, it was mainly "a joyous adventure". The expedition, of which Mr. Shaw gave accounts in *The Times* during August 1935, and later before the Royal Geographical Society, covered by motor-car altogether six thousand three hundred miles, of which some three thousand were in country previously unexplored. Starting from Cairo, the cars travelled along the Nile to Assiut, then south-west to the Gilf Kebir plateau and then by devious ways from oasis to oasis to El Fashir, about four hundred miles west of Khartoum. They returned, mainly westward of their outward route, by way of the Selima oasis, through the Great Sand Sea between Gilf Kebir and Siwa northward to the Mediterranean.

The author's keenest interest lies in the desert, with all its attractions, less apparent perhaps to other travellers, as well as its dangers. The latter have by no means vanished with the coming of the motor-car, although they have changed their nature, and hardships have diminished. As hunter, Mr. Mason, when not engagingly concerned with the desert and incidents by the way, gives his attention mainly to the observation of animal life, more especially in its relation to water supply. Scientific results, however, are recorded in appendixes and a large-scape map. Of these results, the most noteworthy were archæological. The expedition secured some remarkable evidence of the activities of early man in the form of rock-drawings, pottery and the like, as well as skeletons of early man himself, of which some details have already appeared in NATURE (**137**, 159 ; 1936).

American Martyrs to Science through the Roentgen Rays

By Dr. Percy Brown. Pp. xv+276. (Springfield, Ill., and Baltimore, Md. : Charles C. Thomas ; London : Baillière, Tindall and Cox, 1936.) 16*s*.

THIS work contains short and vivid accounts of the life and work of twenty-seven men and one woman—Mrs. Elizabeth Fleischman Ascheim—aged from thirty-five to seventy-seven years at the times of their deaths, who as doctors or technicians in the United States contracted severe X-ray dermatitis and cancer, and died after many years of suffering and operations in the form of skin grafting or amputation.

Among the most eminent of these martyrs were Clarence Madison Dally, who with his brother Charles did valuable work in the development of the various types of X-ray focus tube ; Louis Weigel, who introduced an adaptation of the Wheatstone stereoscope, and invented a tube holder ; Wolfram Conrad Fuchs, inventor of an electrolytic interrupter ; Rome Vernon Wagner, inventor of the mica plate static machine ; and his brother Thurman Lester Wagner ; Charles Lester Leonard, a pioneer in urinary röntgenology and a prolific writer ; Walter James Dodd, who occupies the same place in early American radiology as does Röntgen in the annals of German science ; Eugene Wilson Caldwell, inventor of the liquid interrupter and of a stereo-fluoroscopic apparatus as well as of a practical method for examining the accessory sinuses of the nose ; Frederick Henry Baetjer, author of important papers on the X-ray diagnosis of aortic aneurism and bone tumours ; Francis Le Roy Satterlee, who made valuable contributions to dental radiology ; and William Krauss, a pioneer in the therapeutic use of X-rays.

The text is freely interspersed with portraits and illustrations of röntgenological apparatus and accompanied by bibliographical references. A glossary for lay readers is appended.

A Parson in Revolt

By Joseph McCulloch. Pp. 174. (London : Nisbet and Co., Ltd., 1936.) 3*s*. 6*d*. net.

MR. MCCULLOCH is a young clergyman who delivered a broadcast talk in the "Youth Looks Ahead" series about a year ago. One of the thousand letters received by him as a result of his broadcast is printed in the author's preface to the volume before us. It sheds a clear light on the attitude of many who have a strong desire to satisfy their religious instincts, but do not find the Church of much use to them. "The real difficulty of our time," says Mr. McCulloch, "is in the approach to religion. The modern reaction

is first an intellectual quarrel, then an attack on the institution, and third an expression of a genuine desire for God." But Mr. McCulloch pleads that it is "fundamentally topsy-turvy to attempt to build up a religion by starting with a search for one which is intellectually watertight". This is doubtless the case in so far as the religious need is not *primarily* an intellectual, but an emotional one. At the same time, a religion that is not "intellectually watertight", or at least reasonably so, is not of much use to anybody. Such a religion can only be a more or less deceptive fantasy, and cannot be relied on in a crisis.

The trouble with institutional religion as it exists to-day is that it does not take the claim for "intellectual watertightness" nearly seriously enough. Merely to bring the technique of worship up to date, and to scrap the parochial system (as Mr. McCulloch suggests), is just to scratch the surface of the problem. Beautiful and inspiring worship, and efficient organization, avail nothing if the religion stresses as important beliefs which are not historically or scientifically true. Yet Mr. McCulloch has written an honest, stimulating book. J. C. H.

Physics

Electrical Measurements in Principle and Practice

By H. Cobden Turner and E. H. W. Banner. Pp. xiv + 354. (London : Chapman and Hall, Ltd., 1935.) 15*s*. net.

THE always inadequate literature of electrical measuring instruments is notably strengthened by this addition. The frontispiece in itself is worth having, though it merits printing on three separate pages normally oriented in place of the single much folded sheet, which demands some proficiency in acrobatics for its full enjoyment. The treatment of the measuring instruments of power-engineering and of audio-frequency work is in general satisfactory ; that of the more fundamental work, and of oscillographic work, is not so good ; while the treatment of radio-frequency measurements is definitely amateurish.

Local patriotism and the camera have combined to weaken the balance and usefulness of the work as a whole. The predominance of Lancashire does not extend so far into the instrument field as the proportion of "Salford" illustrations suggests. Photographs, without the inclusion of the invaluable foot-rule, are much less useful to the reader than are line diagrams. The authors have allowed the sales and publicity men to unload on them an undue share of their facile material, as, for example, on p. 241, a "Valve Oscillator. Mains All-Metal Type". The learned judge might, with more reason than usual, ask "What is an all-metal oscillator ?" Whether he might advantageously be invited to turn his attention to p. 143, "experience in the supply of testing instruments to the Government Services has produced robust instruments able to withstand the maximum of rough handling", is a high-politico-legal problem.

The definition of a galvanometer (p. 109) is not good ; the reference to oscillographs on the same page is worse. A galvanometer is not necessarily sensitive ; it is of its very essence that it does not, directly, "measure" D.C. or A.C. ; oscillographs are not merely "a form of galvanometer" and are not of two types—moving coil and cathode ray. The moving iron oscillograph deserves mention, the moving coil oscillograph is not sensitive (as a member of the authors' class of galvanometer must be) and the cathode ray oscillograph would still be a laboratory toy were it only a galvanometer.

The power engineer will probably find the book more valuable than these critical comments suggest. A good book, first edition, would be a very good book, second edition, if attention be given to the points mentioned.

Tables of Physical and Chemical Constants and some Mathematical Functions

By Dr. G. W. C. Kaye and Prof. T. H. Laby. Eighth edition. Pp. vii + 162. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1936.) 14*s*. net.

IT is difficult to imagine a modern physical laboratory which does not possess its well-thumbed copy of "Kaye and Laby" ; and it is a special pleasure to see that our old friend, clad in gayer harness than has been his wont, has now reached his eighth edition.

Kaye and Laby's Tables is a work the utility of which is quite out of proportion to its modest dimensions. In a small and handy volume of tables, the editors have to pick and choose, and they have two main duties to perform : to see to it that they let down the users of the tables as infrequently as possible, and to arrange their matter so that the searcher for a number may find it with ease. How well the editors have accomplished their task is obvious—an eighth edition speaks for itself.

This edition preserves all the old features, and a number of recent data have been added. If a very mild criticism may be ventured, it is that the editors, in their anxiety to introduce new data under the appropriate heading, have had to cut short the amount of new information which they could have given us. In all instances of physical properties which vary with pressure and temperature, it is advisable to list these properties over as wide a range as possible—preferably by means of equations, when dealing, say, with homologous organic compounds. For heavy water, some preliminary investigations have been made, and density, viscosity and surface tension, for example, have been investigated at different temperatures. Exigencies of space have made it impossible for the editors to do more than quote one or two figures—it were impossible otherwise to squeeze them in under their appropriate heads. It is much to be hoped that the editors will, in the ninth edition which is surely contemplated, give the latest information which may be needed in any detail by way of a separate sheet or two at the end of the book. A detailed index, which already exists, would serve as guide, and much more additional information would be easily made accessible to the reader.

The new edition may be heartily commended, both to users of the old editions, and to those unfortunates who know not how Kaye and Laby's Tables *delectant domi, non impediunt foris*. A. F.

Light
By A. E. E. McKenzie. Pp. x+178+10 plates. (Cambridge: At the University Press, 1936.) 2*s*. 6*d*.

THIS unassuming little volume presents the elementary facts of optics to pupils of School Certificate standard in most attractive fashion. The author has evidently written the book *con amore*, and his enthusiasm for his subject should be infectious.

He has accepted the recommendations in the report of the Physical Society on "The Teaching of Geometrical Optics" with respect to sign convention, and of the conventions recommended has adopted that in which distances actually travelled by a ray of light are taken as positive, and distances measured along a virtual ray as negative.

The subject is developed in its usual order, and the book is illustrated by an excellent series of photographs, including a most remarkable photograph of a desert mirage as seen in Persia. An ample number of numerical examples are appended to the chapters.

The book can be unreservedly commended.

A. F.

Philosophy and Psychology

The Way to Happiness for Humanity:
a Modern Philosophy for Everyone. By "Amator". Pp. 324. (London: The Good Hope Publishing House, n.d.) 4*s*. net.

IF it is true that anyone who thinks is a philosopher, it is equally true that anyone who has thoughts to put forward after careful consideration is entitled to do so, provided he satisfies himself of their appropriateness as to form and content. Moreover, if it is true that happiness is the goal of any mortal man, we are all of us entitled, whatever our particular interests, to think of the best means of attaining happiness; and when we consider that our way may be of some use to others, then it is almost our duty to communicate to the world at large the results of our thought. It is probably such and similar thoughts that prompted the anonymous author of this work to write it. In expressing his opinion he shows great courage and a thorough understanding of the issues involved. As an attempt to solve one of the major problems of philosophy, "The Way to Happiness" deserves praise and careful consideration.

Personality Maladjustments and Mental Hygiene:
a Textbook for Psychologists, Educators, Counselors and Mental-Hygiene Workers. By Dr. J. E. Wallace Wallin. (McGraw-Hill Publications in Psychology.) Pp. xii+511. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18*s*.

MENTAL hygiene has become so much a matter of everyday politics that well-balanced books on the subject are welcome. This is a sane and readable account of personality difficulties and how to deal with them. How we wish the dictators and other psychopaths in the world could apply mental hygiene principles to themselves and their henchmen. The author very wisely says: "A large proportion of our social and political distempers can, doubtless, be traced to the disfigured, discordant, dissatisfied personalities that inhabit the earth. . . . Mental health and mental hygiene in international as in personal relations means facing facts and issues candidly and dispassionately, without bias, duplicity, hypocritical diplomacy and subservience to insensate emotional urges."

Twentieth Century Psychiatry:
its Contribution to Man's Knowledge of Himself. By Dr. William A. White. (Thomas W. Salmon Memorial Lectures.) Pp. 198. (London: Chapman and Hall, Ltd., 1936.) 10*s*. 6*d*. net.

THIS series of lectures presented by Dr. White to the New York Academy of Medicine in 1935 makes most interesting reading both to the psychiatrist and to the layman. Psychiatry is an ugly word but has a wide meaning, and it is a pity that the average layman has little idea of its meaning. To-day it covers not only the work of the old-time alienist but also that of the modern workers in mental hygiene, criminology, sociology and wide ramifications in sundry ancillary subjects.

We commend these lectures to those who are sympathetic to what is one of the most technical, most difficult and most exhausting branches of modern specialized medicine.

Technology

Practical Photo-Micrography
By J. E. Barnard and Frank V. Welch. Third edition. Pp. xii+352+23 plates. (London: Edward Arnold and Co., 1936.) 21*s*. net.

THE appearance of the third edition of "Barnard and Welch" is a very welcome event. Broadly speaking, it follows the plan of its predecessors, except for a number of recent developments which add materially to its value. These are concerned with the application of infra-red radiation to microscopy, and an extended technique suitable for opaque objects. In this latter connexion one would have been glad to see some specific reference to recent work on the photomicrography of polished minerals and ores by polarized light, such as has achieved considerable success both at Cambridge and on the Continent. In metallurgical practice, the tendency to forget that magnification exerts little influence upon exposure times (due to the self-condensing action of the objective) is specially mentioned—a most valuable reminder. Again, the photo-micrography of mercury droplets as a method of perfect centration is a very elegant device, beautifully illustrated for both ordinary and dark-ground illumination. As the authors remark, skill and long experience are more important than complex equipment. That is the conclusion which many workers in this field have reached, encouraged maybe by the guidance of "Practical Photo-Micrography".

F. I. G. R.

The Gramophone Record

By H. Courtney Bryson. Pp. xix+286. (London: Ernest Benn, Ltd., 1935.) 21*s*. net.

THE gramophone record industry is so specialized, particularly in the manufacture of disk records, that although the industry is half a century old and substantial developments have taken place in the last decade, there have been hitherto no books or 'inside' information published which give a comprehensive account of the extremely delicate processes involved in making multiplications of a master record perhaps a million times. The author gives an amusing, but intelligent, historical account of the pioneers and their early efforts in recording natural sounds, and then carefully states the nature of the problem and how it is solved at the present time.

The text is profusely illustrated with photographs of technical operations, so that the reader is not left in the air with theoretical notions. The author is a specialist in plastics, and hence the valuable part of the book is concerned with the materials, which are necessarily the limiting factors in making records of technical excellence, their properties and technique of handling. The final chapter deals with possibilities of departing from the prevalent black shiny disk, but the author is not hopeful. We are also pessimistic, since the shellac disk is the cheapest method of obtaining an artistic record which is tolerable, and on account of the rapid decline in the sales of records, the large record firms, which have substantial monopolies, will be loath to change to an improved system. These aspects tend to make the present text the more valuable. L. E. C. H.

Stereoscopic Photography: its Application to Science, Industry and Education.

By Arthur W. Judge. Second edition, revised and enlarged. Pp. xi+340+22 plates. (London: Chapman and Hall, Ltd., 1935.) 21*s*. net.

IN Great Britain the amateur photographer, unlike his colleague on the Continent, is not as a rule interested in stereoscopic photography: its developments therefore have been mainly scientific and industrial. The additional matter contained in this new edition of Mr. Judge's book reflects this condition. The most important advances perhaps are in connexion with medical work, ophthalmic appliances and the recording of X-ray 'screening' experiments under improved conditions. Nevertheless, the classical part of the subject permits of wide extension, such as the application of geometrical optics to the more refined problems of binocular vision. The book is thoroughly practical and provided with an abundance of illustrations.

In the past, it has been difficult to obtain up-to-date information of the kind in English: this volume therefore should appeal to a wide circle of inquirers.

F. I. G. R.

Forthcoming Books of Science

Agriculture and Horticulture

Jonathan Cape, Ltd. Fool's Garden—Muriel Stuart.

English Universities Press, Ltd. The Vegetable Book—W. E. Shewell-Cooper.

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on such a section of a crystal as a crystal face. Hence all observations of small-scale regular markings such as etch figures and slip bands at the crystal surface and especially their minimum dimensions are highly relevant to the subject.

The dimensions of the sharply defined triangular markings shown in numerous photomicrographs[3] of natural (111) faces of diamond are all large compared with the hypothetical dimensions, about 1 μ, of mosaic irregularities. Whilst examining the surface irregularities on some unusually good specimens kindly lent by Prof. W. T. Gordon for X-ray study, it was noticed that a number of regions on one specimen which at ordinary powers of magnification appeared to be free from triangular markings, at magnifications of about 750 diameters showed many minute triangles (Fig. 1). Their orientation was normal, with the angles pointing towards octahedron edges, and the edge of the smallest clearly resolved triangle measured 1·3 μ.

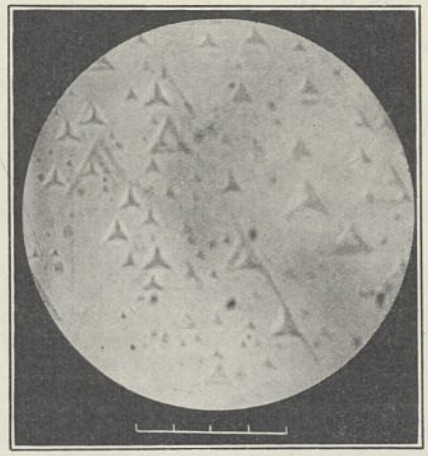

FIG. 1. Photomicrograph of (111) face of a diamond showing some triangular markings of 'mosaic' dimensions. Each scale division represents 0·01 mm.

These abnormally small regular markings were found only in groups and only at the edges of the crystal face. They were not detected on any of the other specimens examined similarly. The specimen measuring about 6 mm. × 4 mm. was the only one from the new diamond field at Sierra Leone. No trace of striations of this 'mosaic' order of magnitude was detected optically, but even the triangular markings themselves were difficult to observe because of their minuteness and the high transparency of the diamond. The optical difficulties were too great to justify an attempt to find the unit size of the largest equilateral triangular network fitting *all* the observed triangles[4]. For the (111) face of bismuth this derived quantity, claimed to be of the order 1·4 μ, is about the same as the observed dimensions of the edge of the smallest triangle on the diamond. Sufficient contrast to see or to photograph the markings was got by defocusing, and I am indebted to Mr. G. A. de Belin for the trouble taken to get the photomicrograph reproduced.

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[1] See Ann. Report Chem. Soc., 189 (1935).
[2] Buerger, *Z. Krist.*, **89**, 195 (1934).
[3] A. F. Williams, "The Genesis of the Diamond", vol. 2 (1932); and J. R. Sutton, "Diamond" (1928).
[4] Goetz, *Proc. Nat. Acad. Sci.*, **16**, 99 (1930).

Optical Experiments on Liquid Helium II

THE anomaly in the specific heat of liquid helium at 2·19° K. has the same shape as that of the λ-point anomaly in crystalline substances. In crystalline bodies the λ-point anomaly, similar to that shown by ferromagnetic bodies at the Curie point, is due to some process connected with a change of order in the crystal.

It is natural to suppose that in the case of liquid helium II we also have to do with some form of order. As this type of transition is observed in liquids when liquid crystals are formed, it is not impossible that liquid helium at temperatures below 2·19° K. also forms liquid crystals.

Liquid crystals are anisotropic, and it is therefore interesting to study the optical properties of liquid helium II. If liquid helium II does in fact form liquid crystals, polarized light, on passing through a layer of helium, must be depolarized, as on its way it traverses a large number of optically anisotropic regions of different orientation.

In our experiments a layer of helium, 10 cm. in length, was placed between crossed nicols. The accuracy was such that a change in the intensity of light corresponding to a rotation of the prisms of ± 1·5° could easily be registered. On cooling the helium from 4·22° to 1·72° K. no change in the intensity of the light could be detected. It is possible that the effect could not be observed owing to the small dimensions of the liquid crystals. We therefore studied the Kerr effect in liquid helium II at 1·72° K. in a constant field of 63,000 volts per cm. No change in the light intensity could be observed with crossed nicols, the planes of polarization of which formed an angle of 45° with the direction of the electric field.

Assuming that the field was sufficiently strong completely to orient the optical axes of the crystals, we have computed that the anisotropy of the refractive index for helium II is less than 7×10^{-8}. If the optical axes were oriented perpendicularly to the direction of the field, this ratio would be 1×10^{-7}.

As the optical anisotropy which might have been expected in helium II lies within the accuracy of measurement, it must be assumed that the anomaly in liquid helium cannot be explained by a transition into the liquid crystal state.

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Ukrainian Physico-Technical Institute,
Kharkov. Sept. 10.

Infra-red Absorption Spectrum of Heavy Phosphine (PD_3)

THE infra-red absorption spectrum of PD_3 has been investigated with the view of testing the applicability of the 'valence force field' in correlating the fundamental vibration frequencies of a pyramidal molecule of the type YX_3. If it is assumed that the valence force field applies to PH_3, then one can deduce the values of the force constants of this molecule from its known vibration frequencies. This has been done by Howard[1], who gives $3·09 \times 10^5$ dynes/cm. for the force required to alter the PH distance, and $0·34 \times 10^5$ dynes/cm. for that required to alter the HPH angle. From these data one may compute the frequencies of the PD_3 molecule (since it is permissible to assume that these force constants are not appreciably altered by the substitution of a

deuterium for a hydrogen atom). The frequencies of PD_3 are thus predicted as $\nu_1 = 1{,}630$ cm.$^{-1}$, $\nu_2 = 1{,}639$ cm.$^{-1}$, $\nu_3 = 775$ cm.$^{-1}$, and $\nu_4 = 871$ cm.$^{-1}$, all of which should be observable in the infra-red.

Strong absorption bands have been observed in gaseous PD_3 at approximately 1,670 cm.$^{-1}$, 790 cm.$^{-1}$ and 730 cm.$^{-1}$. These may reasonably be identified as ν_1, ν_4 and ν_3 respectively. The frequency ν_2 which is not observed in PH_3 is also apparently too weak to be observed in PD_3. Weaker bands have also been observed at 2,325 cm.$^{-1}$ and 3,280 cm.$^{-1}$ which may readily be interpreted as the combination bands $\nu_1 + \nu_3$ and $2\nu_1$ respectively. Three Raman lines have been observed for liquid PD_3 by Hemptinne and Delfosse[2] at 1,664 cm.$^{-1}$, 805 cm.$^{-1}$ and 748 cm.$^{-1}$. These obviously correspond to our three main absorption bands and have, in fact, been given the same interpretation by those authors. The results are tabulated below.

Fundamental Frequencies of PD

	ν_1	ν_2	ν_3	ν_4
Calculated on valence force field	1,630	1,639	775	871
Observed in infra-red (gas)	1,670	—	730	790
Observed in Raman effect (liquid)	1,664	—	748	805

It is immediately obvious that the discrepancy between observed and calculated values is a fairly serious one. It is much larger, for example, than in the corresponding comparison[1] for ND_3. One must conclude that the simple valence force field is a rather incomplete representation of the force field in this type of molecule, and that considerable allowance must be made for interaction and anharmonic terms in the potential function. The determination of those necessitates a very accurate knowledge of the spectrum of PD_3, which is therefore now being investigated under high dispersion.

We are very much indebted to Mr. I. L. Bolland, of the University of Edinburgh, for his kindness in supplying us with the sample of PD_3 used in this investigation.

G. B. B. M. SUTHERLAND.
G. K. T. CONN.

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Sept. 14.

[1] J. B. Howard, *J. Chem. Phys.*, **3**, 207 (1935).
[2] M. de Hemptinne and J. M. Delfosse, *Bull. Sci. Acad. Royal de Belgique*, **21**, 793 (1935).

Atmospheric Oscillations

As is well known, the semidiurnal barometric oscillations indicate that the atmosphere has a free oscillation of a period of 12 hours[1]. On the other hand, G. I. Taylor's evidence[2] from the propagation of waves of explosion points to a free period of $10\frac{1}{2}$ hours. Moreover, the diurnal variation of the earth's magnetic field, when interpreted by the 'dynamo' theory, shows[3] that at the upper conducting layer the pressure oscillations are nearly 180° out of phase with the observed pressure oscillations at the ground. Also, the required conductivity of the layer is larger than the value that can be inferred from radio soundings.

It appears that all the above mentioned facts can be reconciled if we assume a temperature distribution in the atmosphere such as is shown by the curve T in the accompanying figure (Fig. 1). The rise of temperature between 37 km. and 60 km. has been inferred by F. J. W. Whipple[4] from the abnormal propagation of waves from gun-fire, and is in general agreement with the results of similar experiments carried out in Germany. This atmosphere has one mode of free oscillation (1), with a period of about $10\frac{1}{2}$ hours and a corresponding velocity of long waves agreeing exactly with the velocity of the Krakatau wave. It also has another mode of free oscillation (2), with a period very nearly 12 hours. The ratio of the horizontal velocities at any level to the value at the ground is shown by the curves $U^{(1)}$ and $U^{(2)}$. The pressure oscillations are proportional to U. It is seen that, while $U^{(1)}$ is of the same sign throughout, $U^{(2)}$ vanishes at about 30 km., and is of opposite sign at higher levels. The atmospheres above and below this level swing mainly horizontally in opposite

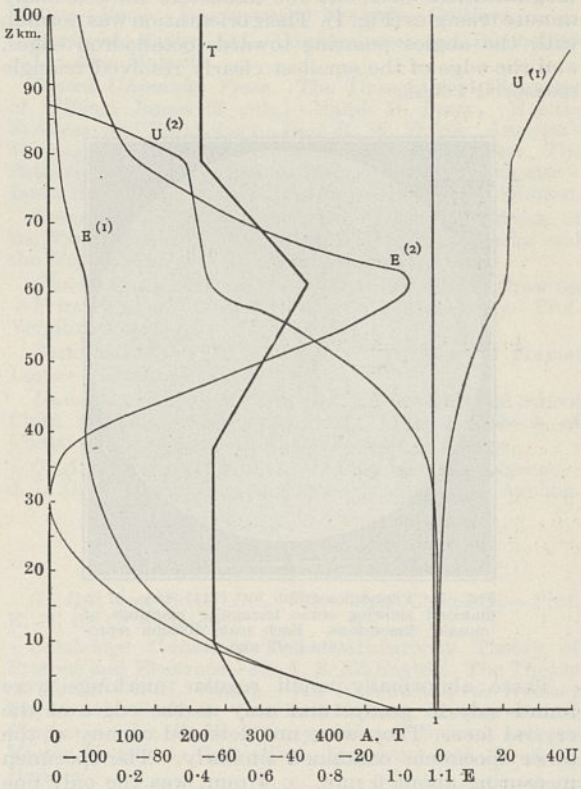

FIG. 1. Assumed vertical distribution of temperature T and computed velocity U and energy density E for the two modes of free oscillation (1) and (2).

directions, and there is a high pressure in one part whenever there is a low pressure in the other. The velocities at the level of 100 km. are, especially in (2), about 100 times greater than at the ground, so that a correspondingly smaller conductivity is required for the conducting layer of the dynamo theory. It will be noticed, however, that the energy densities, which are proportional to the density and the square of the velocities, ultimately vanish exponentially with height, as is shown by the curves $E^{(1)}$ and $E^{(2)}$. From the run of these curves one might expect that a disturbance like the Krakatau eruption which was concentrated at the ground would excite mode (1) and would therefore be propagated with a corresponding speed. That the Krakatau wave was shallow can be inferred from the fact that the wave front was considerably modified by the trade winds, as was shown by Taylor.

Although the motion is mainly horizontal, the large amplitudes of the oscillation at high altitudes are accompanied by considerable vertical displacements of the atmospheric layers. These are of the order of a km. at the 100 km. level, but increase exponentially with height until they begin eventually to be damped by the increasing kinematic viscosity and thermal conduction. It is thus possible that the anomalous variation of height and ionization of the F_2 layer, as reported by Appleton and Naismith[5] and Martin and Pulley[6], might be associated with the semidiurnal oscillation of the atmosphere. Were it not for the retardation by viscosity and conduction, the upper layers would be expected to reach their maximum height at about 9.30 a.m. and 9.30 p.m.

A detailed report of this investigation will appear elsewhere.

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40 Grantchester Road,
Cambridge.
August 22.

[1] S. Chapman, S. K. Pramanik and J. Topping, *Beiträge zur Geophysik*, **33**, 246 (1931).
[2] *Proc. Roy. Soc.*, A, **126**, 169, 728 (1929); *Mem. Roy. Met. Soc.*, **4**, No. 35 (1932); *Proc. Roy. Soc.*, A, **156**, 378 (1936).
[3] S. Chapman, *Phil. Trans.*, A, **218**, 1 (1919).
[4] *Quart. J. Roy. Met. Soc.*, **61**, 285 (1935).
[5] *Proc. Roy. Soc.*, A, **150**, 697 (1935).
[6] *Proc. Roy. Soc.*, A, **154**, 455 (1936).

Fossil Human Remains from Kanam and Kanjera, Kenya Colony

IN NATURE of March 9, 1935 a letter appeared from Prof. P. G. H. Boswell upon this subject, and I should like to comment upon certain issues raised. Prof. Boswell wrote: "Unfortunately, it has not proved possible to find the exact site of either discovery, since the earlier expedition (of 1931–32) neither marked the localities on the ground nor recorded the sites on a map". This sentence gives the impression that no adequate measures were taken to record the position of the discoveries. Actually, steps were taken which would have proved adequate had not all the photographs, taken especially for the purpose, failed owing to an unsuspected hole in the bellows of the camera. I did not record the sites on a map because there was no map of sufficient accuracy available, and I had not the means of making one at that time. I might have tried to obtain the services of a surveyor, but that would have been costly and I was saving all the money I could for a second visit to Oldoway, which I, at the time, believed was more important.

When we went to Kanam and Kanjera, we had only recently returned from Oldoway, where the geologists had decided that the evidence for the great age of the Oldoway skull was geologically sound. I had accepted their verdict[1] (which was proved to be wrong after my return to England[2]) and I had consequently withdrawn my earlier attack[3]. When I was at Kanam the evidence of Oldoway was once more being questioned[4], and so I was arranging to revisit Oldoway with Mr. Wayland, the director of the Geological Survey of Uganda, in order to re-examine the evidence.

Later events have proved that this was an error of judgment, and that it would have been better to get a surveyor for Kanam and abandon the idea of revisiting Oldoway, but it is easy to be wise after the event. I believed at the time that the sites were adequately marked.

In spite of everything, I maintain that I showed Prof. Boswell the actual stratum from which the Kanam mandible was obtained, as well as the position within circumscribed limits. At Kanjera I showed him the exact spot where the residual mound of deposits had stood which yielded the Kanjera No. 3 skull *in situ*. We ourselves dug away most of the mound in 1932, and the small remaining portion had been eroded away. But the fact that I did show Prof. Boswell the site is proved by a small fragment of bone picked up there in 1935 which fits one of the 1932 pieces.

Another issue raised by Prof. Boswell is connected with the accidental use of a wrong photograph. He wrote: "Moreover, the photograph of the site where the mandible was found, exhibited with the jaw fragment at the Royal College of Surgeons, was, through some error, that of a different locality; and the deposits (said to be clays) are in fact of entirely different rock (volcanic agglomerate)." This sentence is even more misleading than the previous one, and there are two points which I must discuss.

First of all, the accidental use of a wrong photograph. As already mentioned, my own photographs of the site all failed, and I consequently had to make use of photographs taken by other members of the expedition. In view of this, I carefully refrained from using any photographs *as evidence* in connexion with my claim for the antiquity of the Kanam mandible, and only used them to show the general nature of the sites. I had among others a photograph taken by Miss Kendrick and marked on the back "Kanam West, site of Deinotherium tooth". Owing to a mistake on my part, which I freely admit and deeply regret, this was taken to be a picture of the site where the deinotherium tooth was found which led to the discovery of the human mandible fragment. I therefore used it in good faith to give a general view of the site. In 1935, we found that this picture was of a different part of the Kanam West exposures (about 400 yards away) where the first deinotherium tooth found in the area came from.

The sentence quoted above ends "and the deposits (said to be clays) are in fact of entirely different rock (volcanic agglomerate)". From articles in the Press (see *Discovery*, April 1935, etc.) and from conversations I have had, it is clear that this sentence has been very widely interpreted both in England, on the Continent and in the United States, as meaning in effect "Boswell says Leakey does not know the difference between a clay and a volcanic agglomerate!" I understand from Prof. Boswell that he did not mean this at all, and that the words were only meant to mean that the deposits visible in the wrong picture are agglomerates whereas the deposits at the site itself are (as I said) clays.

There are several other issues that I would like to discuss, including the meaning of the word 'horizon' in connexion with the Kanjera finds. I used the word in the sense defined by several geological text-books, but it seems to have a different meaning for Prof. Boswell. I will not, however, trespass further on space of NATURE, as I hope to have an opportunity before long to discuss the matter further.

L. S. B. LEAKEY.

Great Munden,
Ware,
Herts.

[1] NATURE, **128**, 724 (1931).
[2] NATURE, **131**, 397 (1933).
[3] "Stone Age Cultures of Kenya Colony", p. 14 *et seq.*
[4] NATURE, **129**, 903 (1932).

Colorimetric Estimation of Phosphorus

To determine the rate of colour formation and the optimum time for taking readings in the Fiske and Subbarow method of estimating phosphorus microchemically, we have used a simple type of photo-electric colorimeter (to be described in detail elsewhere) which allows the chemical reaction to be followed continuously until a state of equilibrium is reached. The method has been developed for the purpose of obtaining more accurate figures for the phosphorus content of the whole blood and its separate fractions (plasma, serum and red cells) than those hitherto obtained by other (visual) methods.

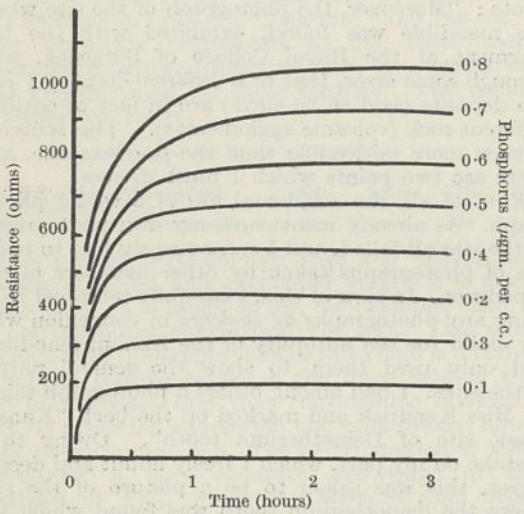

FIG. 1. Relation of colour intensity to time. Curves for the smallest amounts of phosphorus measured have been omitted; in the interests of clearness, the steep ascents in the earlier stages of colour formation have also been omitted.

Our apparatus enables us to detect 10^{-9} gm. of phosphorus per c.c. of solution, and to measure accurately changes of less than 10^{-7} gm. The reagent used, which differs slightly from that given by Fiske and Subbarow, consists of 0·1 gm. of 1 : 2 : 4 amino-naphthol-sulphonic acid, 5·48 gm. of sodium meta-bisulphite, 1·2 gm. of crystalline sodium sulphite dissolved in distilled water to make 50 c.c. of the solution. When the component substances are in these proportions, the acid remains in solution unless the temperature changes markedly. A beam of approximately monochromatic light which, passing through a liquid filter containing the solution to be examined, falls on to a photo-electric cell and so gives rise to a photo-electric current, is balanced against a current generated by a beam from the same source, which has, however, passed through a glass vessel containing only distilled water. After the addition of 2 c.c. of an ammonium molybdate and sulphuric acid solution and then of 1 c.c. of the modified Fiske and Subbarow reagent to the test solution, the characteristic blue colour that forms may be followed by means of a variable resistance which is manipulated so that the spot of light of a mirror galvanometer (of low resistance) remains undeflected.

By measuring solutions containing known amounts of phosphorus (from 0·03 to 1 microgram per c.c.) we calibrated the instrument to express intensity of colour in terms of the balancing resistance; it was found that, roughly, a difference of 0·05 microgram of phosphorus per c.c. produced a colour which caused a change of resistance of 50 ohms, a difference of 1 ohm producing an easily perceptible deflection even with an ordinary laboratory galvanometer. The calibration curve is very nearly linear. When the intensity of colour, expressed in ohms, is plotted against time, curves of the type shown in Fig. 1 are obtained.

These curves show that the colour begins to form immediately after the reagents have been added and increases rapidly in intensity until a comparatively steady state is reached: actually, the colour continues to deepen for many hours. When the quantity of phosphorus present is very small, this approximately steady value is attained in about 20 minutes, but when the amounts are of the order of 0·5 μ gm. per c.c., the colour should not be read until two hours have elapsed since the reagents were added. The curves shown in Fig. 1 are drawn from readings taken at intervals of $2\frac{1}{2}$ minutes in the early stages, then 5 minutes, later 15 minutes and hourly. It also follows from these curves that, when the colours are read in the ordinary ocular colorimeters, the varying rates of development of colour in the standard and the unknown will escape notice owing to the relative insensitiveness of the method.

A merit of the present apparatus is that once the calibration curve for standard amounts of phosphorus has been determined, it is no longer necessary to prepare a standard for comparison with the unknown solution, since the liquid filter used to obtain an electrical balance need contain only distilled water. The advantage of being able to measure accurately the successive changes of colour in the solution is obvious.

The same method is now being applied to other standard colorimetric tests, and it appears probable that the interval of time within which the respective colours are to be read will be found, as in the present case, to be greater than that usually allowed, since more accurate results will be obtained when the measurements are made on the nearly horizontal branches of the resistance curves. In some tests, such as that for cholesterol, it will be possible to determine the optimum time for reading the colour before it begins to fade.

Under the auspices of the Cancer Research Committee of the University of Sydney, we are using the above method to measure the amounts of certain constituent substances in pathological human blood.

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Surface Properties of Non-Aqueous Solutions

A CLOSE study of the surface properties of capillary-active solutions of compounds forming homologous series has shown that the surface activity increases regularly with the molecular weight (Traube's rule). Only aqueous solutions have, however, been thoroughly investigated, and little is known of non-aqueous systems. Since organic solvents have much lower surface tensions than water, the changes produced by solutes will doubtless be much smaller, but the following results show that in certain solvents interesting effects of a similar nature can be observed.

I have determined the surface tension of solutions of different normal alcohols in aniline by means of a Traube stalagmometer. Aniline was chosen as solvent because of its comparatively high surface tension ($\varsigma_{20°} = 42·9$ dynes/cm.). Although the lowering of the surface tension ($\Delta\varsigma$) is much smaller than in aqueous solutions, it was clearly established that, as

in water, $\Delta\varsigma$ is the greater the higher the concentration (c) of the alcohol and that for isomolecular solutions of different alcohols $\Delta\varsigma$ is the greater the higher the molecular weight. The surface tension-concentration curves were of the same type as generally encountered in aqueous solutions, that is, ς falls most rapidly at small concentrations. For dilute solutions (c less than 0·1 mol./lit.) $\Delta\varsigma/c = F$ can be regarded as constant and the following table gives the F-values for the different alcohols :

Alcohol	F
Ethyl	(1·6)
Propyl	3·4
Butyl	6·5
Amyl	9·6
Hexyl	12·8
Octyl	18·8
Decyl	25·2
Dodecyl	31·0

While in aqueous solutions F progresses geometrically as we ascend the homologous series, we find here a regularity of a less pronounced character, namely, from propylalcohol onwards the F-values form an arithmetical progression as do the molecular weights. Thus while in aqueous solutions F_{n+1}/F_n is a constant (generally 3), we find here $F_{n+1} - F_n =$ constant $= 3$.

The fact that F_{n+1}/F_n approaches the value 1 as we move up the series indicates that the influence of the additional CH_2-group upon the surface energy becomes the smaller as the hydrocarbon-chain becomes longer.

It remains to be seen whether in other cases where the solutes have much smaller surface tensions than the solvent similar relationships will be found.

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Rate of Absorption of Oxygen by Sodium Sulphite Solution

DURING the course of some measurements on the rate of absorption of gaseous oxygen by aqueous sodium sulphite solution, it was found that, under certain conditions, stirring the liquid beneath the surface without in any way agitating the latter *decreased* the rate of absorption below that of the unstirred liquid.

The apparatus used consisted essentially of a glass tube into the bottom of which a glass rod was sealed to act as a pivot for a glass stirrer below the liquid surface. This stirrer was hollow and contained iron wire so that it could be moved, by means of a magnetic field rotated externally, without breaking the liquid surface at any point. The other end of the tube was connected to a manometer. This portion was constructed in triplicate to ensure adequate control, and provision was made whereby the whole apparatus could be exhausted and the gas to be used admitted as required, each tube then being connected separately to its particular manometer.

Two tubes of approximately normal sodium sulphite solution were compared; each of these contained similar stirrers but only one of them was stirred (care being taken not to agitate the liquid-gas surface). After the initial rapid absorption, when the rate had become constant and after applying corrections, it was found that the rate of gas absorption by the solution the bulk of which was stirred was in general 48 per cent *less* than the rate at which the gas was absorbed by the unstirred liquid.

A systematic study of this phenomenon is being undertaken, and it is hoped to publish some of the results of the investigation shortly.

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Enolization of Oxycholesterilene

$\Delta_{5:6}$-UNSATURATED sterols may be converted to the 7-dehydro compounds by the method of Windaus, Lettré and Schenck[1]. An alternative route, which is being examined in these laboratories, lies in the enolization of 7-ketocholesterol (I).

Acetylation of (I) resulted in the removal of the C_3-hydroxyl, oxycholesterilene and the acetate of oxycholesterilene being obtained. The latter compound (II) had m.p. 90°–92°, $[\alpha]_D$ − 222°, $[\alpha]_{5461}$ − 283° (found: C, 82·0; H, 10·9. Calc. for $C_{29}H_{44}O_2$: C, 82·1; H, 10·4 per cent). Unless a shifting of the double bonds has taken place, this compound (II) will have the structure shown in

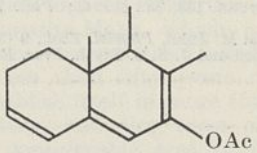

FIG. 1.

Fig. 1. Its ultra-violet absorption spectrum has been examined by Dr. R. K. Callow, who reports that it is consistent with this formula. In view of the mobility of the ergosterol ring system, however, the product m.p. 90°–92° may be contaminated with an isomeride.

This point is at present under investigation. Methods for the preparation of $\Delta_{5:6:7:8}$-cholestadiene-3 : 7-diolacetate are being examined and the results will shortly be published elsewhere.

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[1] *Ann.*, **520**, 98 (1935).

Bilateral Gynandromorphism in Feathers

LILLIE and Juhn[1] suggested that the reactivity to œstrone sometimes manifested only on one side of a feather depends upon a low growth-rate of the tissue at the time, which rate they considered may be different on the two sides. These original views were immediately criticized by other workers[2,3]. They seem to have been greatly modified in exhaustive papers by Fraps and Juhn[4]; but it does not appear that the senior author has abandoned them.

Greenwood and Blyth[5] have shown that asymmetrically coloured feathers may be produced in the Brown Leghorn capon by the intra-dermal injection of small doses of œstrone. I have sectioned the bases of six asymmetrically marked feathers obtained in this way in which the rachis was substantially straight and the barbs on each side of a similar length. I have counted in a section the barbs cut on each side and compared the lengths of the two halves of the collar. The side of the feather which had reacted most to œstrone corresponded with the larger side of the germ and had therefore on the concrescence theory presumably grown more slowly (as required by the theory of Lillie and Juhn) in two

cases. The opposite was true in three cases. There was no discernible difference in one case. The differences were small—perhaps trivial. Five of them lay between two and seven per cent of the total number of barbs cut in the section used. One specimen, however, showed nineteen per cent excess of barbs on the non-reacting side—the opposite of what Lillie and Juhn would seem to require. The differences in length between the two sides followed closely the differences in number of barbs. In each case the œstrone mark was on the side of the feather directed towards the site of injection.

These results do not appear to afford support to the theories of Lillie and Juhn, but seem to agree rather with the results of Greenwood and Blyth. It is hoped shortly to publish a fuller account elsewhere of this and similar work from this Department.

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University College, Hull.
Sept. 17.

[1] F. R. Lillie and M. Juhn, *Physiol. Zool.*, **5** (1) (1932)
[2] P. G. 'Espinasse, NATURE, **133**, 330 (1934).
[3] A. Hosker, NATURE, **133**, 382 (1934); *Phil. Trans. Roy. Soc.*, B, **226**, 143 (1936).
[4] R. M. Fraps and M. Juhn, *Physiol. Zool.*, **9** (3) (1936).
[5] A. W. Greenwood and J. S. S. Blyth, *Proc. Roy. Soc.*, B, **118**, 122 (1935).

Origin of the Word 'Solute'

IN view of the recent discussion as to the first use of the word 'solute'[1], it may perhaps be of interest to notice that the word is used in 1732 in the modern sense by Boerhaave[2], in the Latin form *solutum*. In discussing the action of solvents, he states that the effect is the division of the dissolved substance into particles which are thoroughly mixed with the particles of solvent: "ut particulae solventis inter partes divisas soluti", which Shaw[3] translates: "so that the particles of the solvent remain thoroughly intermixed among those of the solvend". The name is used by Boerhaave throughout his long discussion of solutions, although he sometimes speaks of *partes solvendi* as an alternative. Whether the name is used before Boerhaave I cannot say.

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Wembley,
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[1] NATURE, **137**, 831 (1936).
[2] "Elementa Chemiæ", Leyden (1732), vol. 1, p. 669.
[3] "A New Method of Chemistry . . . translated from the Original Latin of Dr. Boerhaave's Elementa Chemiae", London (1741), vol. 1, p. 489.

Points from Foregoing Letters

SIR C. V. RAMAN and N. S. Nagendra Nath give a brief outline of the several stages by which the theory dealing with the diffraction of light by high-frequency sound waves was developed, and state that its latest extension explains several additional facts, including the reason why supersonic waves can be seen directly through a microscope focused on a plane to the rear of a sound-wave cell.

A photomicrograph of a (111) face of diamond showing triangular markings of the size predicted by the 'mosaic' hypothesis of crystal structure is submitted by Dr. W. H. George. According to that hypothesis, even in a perfect crystal the uniform lattice structure is interrupted over narrow regions distributed periodically throughout the crystal.

Experiments with liquid helium by L. W. Shubnikov and A. K. Kikoin show that it does not form liquid crystals at 2·19° K. The anomaly in the specific heat of liquid helium observed at that temperature cannot therefore be ascribed to a transition to the liquid crystalline state.

The infra-red spectrum of heavy phosphine (PD_3) has been investigated by Dr. G. B. B. M. Sutherland and G. K. T. Conn. Their results (which agree quite well with those on the Raman spectrum of the molecule), do not agree so well with the frequencies predicted from the spectrum of ordinary phosphine (PH_3), thus indicating that a simple valence force field is not very satisfactory for correlating the vibration frequencies of a molecule of this type.

C. L. Pekeris points out that when the increase of temperature in the atmosphere between the levels of 30 km. and 50 km. is taken into account, the atmosphere is found to possess two modes of free oscillations of periods of $10\frac{1}{2}$ hours and 12 hours respectively. In the 12-hourly oscillation there is a nodal surface at about 30 km., the atmospheres below and above it swinging in opposite directions. Various observed facts from the oscillations of the barometer, the propagation of waves of explosion and the diurnal variation of the magnetic field are thereby explained. It is also suggested that the anomalous behaviour of the F_2 layer might be associated with the semi-diurnal oscillations of the atmosphere.

Dr. L. S. B. Leakey, commenting upon Prof. Boswell's report on fossil human remains from Kenya, describes the events which led to the inadequate location of the sites.

A method of determining by means of a photo-electric cell the colour changes produced by chemical reagents, enabling the chemical reaction to be followed continuously, is described by Dr. H. L. Brose and E. B. Jones. Graphs are submitted showing the change with time in the intensity of the blue colour produced in the microchemical estimation of phosphorus by the method of Fiske and Subbarow.

The surface tensions of solutions of various alcohols in aniline have been measured by R. Aschaffenburg. As in aqueous solutions, the surface activity increases regularly with the molecular weight, but the regularity was found to be different from Traube's rule.

Stirring the interior of a solution of sodium sulphite (without disturbing the surface) *decreases* the rate at which it absorbs oxygen by 48 per cent, according to W. S. E. Hickson.

Dr. V. A. Petrow states that acetylation of 7-ketocholesterol leads to the removal of the C_3-hydroxyl and the formation of the acetate of 7-hydroxycholestatriene.

P. G. 'Espinasse reports that in six regenerating feathers examined there was no clear relation between the lengths of the two halves of the collar and the reactivity to œstrone of the two sides of the feather produced by them. As the feathers were substantially straight, it appears unlikely therefore that growth-rate determines this reactivity.

Research Items

Eskimo Cultural Origins in East Greenland

AFTER taking part in Helge Larsen's archæological investigations in Dødemandsbogten on Clavering Island, P. V. Glob excavated twenty-seven houses and a number of graves in Eskimo settlements in Kempe Fjord and King Oscar Fjord (*Meddelelser om Grønland*, 102, 2). These settlements had long been deserted when the fjords were first navigated and mapped by the Swedish expedition under A. G. Nathorst in 1899. Their culture in fact falls entirely within the eighteenth century. The finds from north-east Greenland have been classified into (1) an early culture, coming from the south, comprising Ingsuk types; and (2) a mixed culture in two stages, the early and later north-east Greenland culture, consisting of types from the north, the Thule culture, and local types. The Kempe and King Oscar Fjords settlements do not show evidence of the early culture. The characteristic oval house is absent and no house contains Ingsuk types only. The culture found is the Northeast Greenland in its earlier and later forms, though certain types are new. As found here, it probably originated outside the area, as the result of an admixture of Eskimo with a Thule culture from the north and Eskimo with an Ingsuk culture from the south. The house types fall into two groups, in the earlier of which the house type is large. The small house represents a late stage which was degenerate with diminishing numbers. In the group of large house types there is indication of an additional element from the south, marked by the four-sided house, as well as of the incoming of the later stage of Northeast Greenland from a source not evident, but clearly one in which the Thule types had persisted. A noteworthy feature was the occurrence in a number of houses, in which artefacts were usually numerous, of isolated human jaw-bones. Six in all were found. The reason for their occurrence is not clear, but it may be due to disposal of the dead by partial exposure.

Ethnology of Futuna

IN a report on the information collected during a visit to Futuna and Alofi, islands about 150 miles north of Fiji, in 1932 (Bull. Bernice P. Bishop Museum, No. 138), Mr. Edwin Burrows states that the islanders have been little affected by change. Some of their dances and ceremonies are still performed in the traditional manner, and activities, such as the construction of houses and canoes, agriculture, the preparation of food, and the making of bark-cloth and clothes are unaffected. In such small islands as these, the culture is simpler than in the large Polynesian units, and many features of Samoan and Tongan social organization are absent. For example, there are no talking chiefs and no village maids as in Samoa, nor are there sub-chiefs and a chiefs' language as in Tonga, nor is there the Tongan practice of assigning each individual a fixed position within the kindred. On the other hand, practices now lost elsewhere are here found as essential cultural features—for example, inheritance of the position of master craftsman. Futunan culture, therefore, is not only Western Polynesian, but early Polynesian. Thus, two methods of making bark-cloth are found, felting and pasting. Felting is practised as the only method of making bark-cloth in Hawaii, the Society Islands, the Marquesas, the Cook Islands, the Tuamotus and, in fact, throughout the eastern Polynesian area, with the exception of New Zealand. Pasting is the method of Samoa and Tonga. While both are present in Futuna, there is evidence that pasting is here the more recent. The distribution suggests that felting is the old method, while pasting was invented in Samoa and Tonga and the old method forgotten. The different methods of decorating bark-cloth seem to have a like local origin, freehand drawing being the oldest.

The Argentine Ant in the United States

SOME time previous to 1891 this ant, known as *Iridomyrmex humilis* Mayr, which is an inhabitant of South America, entered the United States at New Orleans. In less than fifty years it has come to invade and establish itself in more than 4,000 square miles of territory, including most of the Southern States and a considerable area of California. An account of this insect, together with methods of its control, has been written by Mr. M. R. Smith (*Circ.* No. 387, U.S. Department of Agriculture, May 1936). It appears that the ant becomes disseminated chiefly via railroad commerce, and is readily transported in consignments of lumber, plants, dry goods, etc. The hold which it has obtained in its adopted territory is due to its ability to produce enormous numbers of individuals able to exterminate competitive species. It thrives both in human habitations and in the open, and can exist up to 4,000 feet. It is chiefly as an indoor pest that it is most troublesome: it is omnivorous and swarms on foodstuffs, etc. Out of doors it affects poultry-keeping and often kills young chicks to obtain their blood: this ant also invades beehives besides fostering aphids and mealy bugs. The official recommendations for its control include systematically planned poisoning by means of a mixture of syrup and sodium arsenite, placed in small containers at specified intervals throughout infested areas.

Northern Harpacticids

KARL LANG has investigated the harpacticids from the Swedish Expedition to Spitsbergen 1898 and Greenland 1899, and although the material was difficult to handle, having been laid aside for more than thirty-five years in alcohol, he has found in it much that is new and interesting ("Die während der Schwedischen Expedition nach Spitzbergen 1898 und nach Grönland 1899 eingesammelten Harpacticiden. *Kungl. Svenska Vetenskapsakademiens Handlingar*. Tredje Serien. 15, No. 4; 1936). There are many new species and these were mostly taken in deep waters (1,750 m. and 2,700 m.) at a greater depth than any harpacticids have been collected before in these regions. The number of species is comparatively large, the number of individuals, in most cases, very small and often confined to a single individual. The present work is purely systematic, the author intending to deal with the geographical distribution in

further publications. New species are described of *Cerviniopsis*, *Bradya*, *Stenhelia*, *Ameira*, *Parameschra*, *Argestigens*, *Eurycledotes*, *Mesocledotes*, *Hemicledotes*, *Paranannopus* and *Rhizothrix*, whilst a new genus and species *Canuellopsis typica* is proposed for a form closely related to *Canuella*. *Eurycledotes echinatus* n.sp., collected at a depth of 1,750 m., possesses a very peculiar alimentary canal, the stomach reaching the third abdominal segment and being strongly lobed before narrowing to a funnel-shaped end with a thick circular muscle. At the sides are large glands, enormously developed. The author suggests that the hind part of the gut may serve for respiration in these great depths. Keys to the species of *Eurycledotes*, *Mesocletodes* and *Rhizothrix* are given.

A New Group of Filterable Organisms

Sir Patrick Laidlaw and W. J. Elford (*Proc. Roy. Soc.*, B, 120, 292; 1936) have been searching for new organisms in sewage. They removed all visible organisms by filtering the sewage through gradocol membranes with an average pore size between 0·6 μ and 1 μ. The filtrates contained a new group of organisms which may prove to be a link between the larger bacteria and the pathogenic viruses. The larger forms have a diameter of about 0·5 μ, and are visible under dark-ground illumination as small rings. The smallest forms have a diameter of about 0·15 μ. The organisms can be grown in a rich broth. If the small forms are filtered off and cultured, large forms develop, so that the same organism probably varies widely in size at different periods of its life history. The organisms appear to be purely saprophytic, because it was impossible to produce any obvious disease when cultures were administered in various ways to rats, mice and rabbits. Several closely related strains were distinguished immunologically in material from different sources.

Geometrical Laws of Egg Cleavage

It is obvious that the planes of cleavage in the developing egg are conditioned, within limits, by mathematical or rather geometrical laws. Monteil ("L'Oeuf." G. Doin and Cie, Paris, 1936) discusses these geometrical ideas so far as they are applicable to alecithal and telolecithal eggs exhibiting radial and oblique segmentation. The nucleus at the commencement of division tends to take up a position at the centre of gravity of the cytoplasm of the cell and this, while it does not have much effect in the alecithal ovum, is of great importance in the telolecithal ovum. In order to allow for the influence of the yolk in the latter type of egg and not to make the interpretation too complicated, the author deals with the yolk-containing portion of the egg as if it could be divided into zones each with simple proportions of cytoplasm and yolk and the proportions varying from no yolk to no cytoplasm. The axis of the spindle is in general parallel with a tangent to the surface of the egg sphere, and as the cleavage planes are at right angles to this it follows that the internal surfaces of the cells are walls of polyhedrons and not of cubes as is usually depicted in diagrams. Thus, for example, in the eight-celled stage of the frog's egg, the lower internal surfaces of the micromeres together form four sides of a tetrahedron the angles of inclination of which are determinable because they are at right angles to the spindle axes. While the geometrical figures involved in the early stages are simple, they become more and more complex as segmentation proceeds. The provision of short summaries and a large number of diagrams adds considerably to the ease of following the argument.

Pollination of Plums

The effective pollination of orchard crops is an essential factor in the production of satisfactory yields of fruit, and in many cases care must be taken to interplant self-sterile varieties with other sorts to act as pollinators, in which case the flowering periods must overlap. Though the main English plum varieties Czar, Purple Pershore, Victoria and Giant Prune appear to be largely self fertile, cross-pollination is advantageous, and with many other varieties is essential. A recent paper by C. H. Hooper (*J. South Eastern Agric. Coll., Kent*, 38; 1936) contains a classification of plums relative to their degree of self-fruitfulness, and a useful table is given to show varieties in flower at the same time. Pollination is brought about mainly by bees, but observations recorded in the paper cited show that the blossoms are visited by a number of other insects which were counted and identified. The data on flowering periods should prove a useful guide when plum orchards are being planted.

Bactericidal Action of Radiation

The bactericidal action of radiation depends on a number of factors such as the duration and intensity of the exposure, the wave-length, and the nature of the bacterium. A simple and accurate method of studying the effect of these factors has been described by G. Dreyer and M. L. Campbell-Renton (*Proc. Roy. Soc.*, B, 120, 447; 1936). The organisms are spread out evenly on an agar plate. Radiation is then allowed to fall on a localized area about 3 mm. in diameter. A number of such small areas can be treated with different times of exposure or different wave-lengths. The plate is incubated for 22 hours. It is then placed in the 'reading machine', in which a beam of light is thrown obliquely up and the amount of light scattered by the organisms is measured in a gas-filled potassium photo-electric cell. After applying a correction for the dead background, the authors calculate the percentage of survivors from the amount of light scattered in the spot, expressed as a percentage of the amount of light coming from a neighbouring untreated spot. They find that the product of the intensity and duration of irradiation for a given effect is constant over at least an 8-fold range. The shape of the curve connecting percentage growth with log (duration) varies when different organisms are used. The relative bactericidal action of different wave-lengths also varied irregularly and the effect was not proportional to the energy, but in all cases the line 2655 A. was the most effective. The effects of disinfectants were also studied by applying drops of different dilutions to localized areas on agar plates and measuring the effect by the method used in studying the effect of radiation.

Promotion of Nitrogen Fixation in Tropical Soils

At intervals since the beginning of the present century studies have been made of the value of molasses as a soil improver, and a number of investigators have examined the possibility that the action of the molasses was partly an indirect one, that of

increasing nitrogen fixation. As there has been a certain conflict of results, particularly on the practical side, there is room for further investigation of the problem, and the contributions of Prof. N. R. Dhar and his co-workers at the University of Allahabad are to be welcomed. They have already shown considerable nitrogen fixation under tropical conditions when energy-rich materials such as soluble carbohydrates or molasses are added to the soil. They are now attacking the general problem of increasing soil nitrogen by supplying the nitrogen-fixing organisms with sources of energy, and in a communication to the Editor dated August 18, 1936, Prof. Dhar and Mr. S. K. Mukerji report appreciable gains in nitrogen content when soils, to which filter paper, dried leaves, or leaf juice had been added, were kept under laboratory conditions for several months. There were still greater increases in nitrogen content when molasses was also added, while soils exposed to sunlight for 6 hours daily gained slightly more than those kept in the dark. Sodium salts of organic acids, namely, sodium citrate, stearate, palmitate and oleate, exposed to light under similar conditicns gave smaller but consistent increases in soil nitrogen From one half to two thirds of the added carbon was oxidized at the same time. The authors point out that since molasses and cellulosic materials not only increase the humus content of the soil and improve its physical condition, but also promote nitrogen fixation, the manuring of tropical soils with such substances should be a highly important practical proposition.

Original Laterite of Buchanan

MUCH of the controversy as to the nomenclature of laterites has resulted from the fact that no exact data concerning Buchanan's original laterite have been available. In order to settle the question, Dr. C. S. Fox visited the type localities in Malabar during 1933. His results are now published (*Rec. Geol. Sur. India*, 389–422 ; 1936). From this paper, it is clear that Buchanan's laterite consists mainly of what would now be called lithomargic laterite and even, in part, lateritic lithomarge. The rocks studied by Buchanan represent but a stage in the passage from granites and gneisses, through kaolin or lithomarge, to a rock consisting mainly of hydrated oxides of alumina and iron in which combined silica is characteristically absent. The latter portion of this process of weathering is now generally known as lateritization, and the finished product is called laterite. Thus Buchanan's 'laterite' is an intermediate form needing some qualifying adjective such as *lithomargic*. Dr. Fox has shown a sense of proportion in recognizing the facts of present usage. Otherwise, had he insisted on a purely academic application of the law of priority, the term laterite would have to be restricted to the lithomargic rocks studied by Buchanan ; a completely new term would have to be adopted for the high-level fully formed laterites of the Deccan and elsewhere ; and the term lateritization would have to be abandoned. Fortunately, there is no suggestion that any such confusion is likely to be introduced.

Constants of Diatomic Molecules

THE accumulation of spectroscopic data concerning such molecular constants as vibration frequency, ω_e, and internuclear distance, r_e, for diatomic molecules is stimulating further efforts to determine a more accurate relation between these constants. Allen and Longair, Badger and Douglas Clark have each suggested different modifications of the approximate Morse rule, $\omega_e r_e^3 =$ constant. It is found that the results are more satisfactory if attention is paid to the periodic groups to which the atoms forming the molecule belong. Consequently each of the three modifications contains a period constant. Douglas Clark and Howell have also shown that a simple relation exists between the ω_e values of such molecules as A_2, B_2 and AB where A and B belong to the same group. It appears that ω_{AB} is almost equal to the arithmetic mean of the frequencies ω_{A_2} and ω_{B_2}. Dr. N. R. Tawde, of the Royal Institute of Science, Bombay, has sent to NATURE a communication containing the substance of a paper by him, to appear in the *Bombay University Journal*, in which he discusses the same result and also describes his investigation of the variation of the ratio B_e/ω_e for molecules within a given periodic group. As a result of this study, he finds it possible to estimate values of B_e for a number of molecules, and, ultimately, to determine r_e from the relation $B_e = h/8\pi^2 M r_e^2$. Where it is possible to check these calculated values against those already established, agreements to within 2·5 per cent or better are obtained.

Refrigeration in Agriculture

"REFRIGERATION FOR THE FARM AND DAIRY" is the title of an illustrated bulletin by C. A. Cameron Brown, published by the Institute for Research in Agricultural Engineering, Oxford (1*s*. 6*d*.). The preparation of the bulletin was prompted by the number of inquiries on the subject of milk cooling recently received by the Institute, and it is specially intended for the guidance of farmers, small dairymen and in particular the producer-retailer. After an introductory account of the theoretical side of refrigeration, the compression and absorption systems for obtaining the low temperatures are discussed from the practical point of view, the comparative suitability of the various chemicals that can be used, the type of plant employed and its efficiency all coming under review. The second half of the bulletin deals with the application of refrigeration, chiefly in relation to dairying. A full description is given of the two principal methods for cooling milk, namely, the direct-expansion and the circulation methods. The important question of sterilizing is not overlooked, for the choice of cooling plant may be largely determined by the technique in sterilizing preferred. Cold storage is also considered in detail, the equipment required, its mode and operation being fully described, while figures for running costs are quoted from actual farms. Smaller sections are devoted to the question of portable cooling for the dairyman, and refrigeration on the fruit farm, in the bulb and market gardening industry and in poultry farming.

Ammonium Mandelate in Urinary Infections

IN a note in a former issue of NATURE (June 20, 137, 1027), reference was made to this agent in the treatment of *Bacillus coli* infections of the urinary tract, and to a granular form of this compound, 'Neoket', supplied by Boots Pure Drug Co., Ltd., Nottingham. Messrs. Boots now supply an 'elixir' in fluid form, in which the unpleasant taste of ammonium mandelate is successfully covered by the use of suitable flavouring agents, and which is therefore more palatable than 'Neoket'.

International Union of Geodesy and Geophysics

GENERAL ASSEMBLY AT EDINBURGH

THE sixth General Assembly of the International Union for Geodesy and Geophysics was held at Edinburgh during the period September 17–25, under the presidency of Dr. William Bowie (U.S.A.). Of the thirty-two countries that adhere to the Union, twenty-one sent delegates, and in addition thirty guests attended from ten countries (including Germany, Austria, Russia, India, Australia) that are not at present members of the Union. The delegates, guests and those accompanying them numbered in all 378, of whom 261 came from overseas.

At the opening meeting, held on September 17 in the McEwan Hall, the Union was welcomed by the president of the Royal Society, the Lord Provost of Edinburgh, the principal of the University of Edinburgh, and the president of the Royal Society of Edinburgh. The University of Edinburgh conferred its honorary doctorate on the president of the Union, Dr. William Bowie, in the course of the proceedings.

The scientific work of the Union is done by the seven international associations included in it, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, vulcanology and hydrology. Each of these held many meetings during the Assembly, some of them commencing their proceedings so early as September 14. Two evening lectures, by Dr. A. L. Day (U.S.A.) on volcanoes, and by Dr. Vening Meinesz (Holland) on gravity measurements in submarines, were given for the public of Edinburgh, and were largely attended.

Social hospitality was accorded to the Union by H.M. Government and the City of Edinburgh, both of which gave evening receptions; the City also gave a garden party. The British National Committee for Geodesy and Geophysics, which organized the meeting, with the aid of Government funds provided through the Royal Society, arranged a Sunday all-day train excursion to the Highlands, and an afternoon party on the closing day of the Assembly. Other afternoon parties were held at the Royal Scottish Museum, where an exhibition of geodetic and geophysical instruments, arranged in connexion with the Union meetings, was opened by Sir William Bragg; and at the Royal Society of Edinburgh, and the Castle. Excursions were also made in connexion with several of the Associations.

The scientific work of the Associations covered too wide and varied a field even to be summarized here. International co-operation is of special importance in the earth sciences, and many useful schemes of international work were initiated or continued. Co-operation between the different Associations is also of importance, and one step taken in this direction at Edinburgh was to set up a special joint commission of the Associations to investigate problems of the earth crust under the oceans.

Among the special papers discussed by the Association of Geodesy were two on pendulum and crystal clocks, by Sampson and Rayner respectively, and one by Bullard on gravity work in East Africa.

The Association of Seismology continued its support of the International Seismological Summary. Among the papers discussed by this Association were one on deep-focus earthquakes, by Gutenberg and Richter, and one on a new type of vertical seismograph, by Somville. On the proposal of Prof. Ishimoto it was recommended that seismic observatories should communicate, for the International Seismological Summary, the direction of the initial displacements in earthquakes.

At the Association of Meteorology about thirty papers were read, and in conjunction with the Association of Oceanography resolutions were adopted urging a more effective collection than heretofore of meteorological data over the oceans; they recommended (1) the creation, with the aid of merchant ships, of an ocean network of upper air soundings, (2) the stationing of a ship near 55° N., 30° W., the region where cyclones most often form, to make meteorological, ærological and oceanographic observations and to collect and re-transmit observations of merchant ships, and (3) an increase in meteorological (particularly upper air) observations in Iceland and the Azores.

Among the decisions made by the Association of Terrestrial Magnetism and Electricity was one to organize temporary observatories to take quick-run records of long-continued magnetic pulsations in Iceland, where they appear to be specially frequent.

Under the auspices of the Hydrology Association many meetings were held, including what appears to have been the first International Commission on Snow, which was largely attended. This Association, like those of Vulcanology, Magnetism, Meteorology and Oceanography, took part in special scientific excursions, in addition to the social excursions arranged for the whole Union.

The administration of the Union will continue to be in the charge of Brigadier H. St. J. Winterbotham as general secretary. The Executive Committee includes the presidents of the Associations, who were as follows: names in brackets indicate new elections for the forthcoming three years: Geodesy, Vening Meinesz, Holland; Seismology, Oddone, Italy (Heck, U.S.A.); Meteorology, V. Bjerknes, Norway (Chapman, Great Britain); Oceanography, Knudsen, Denmark (Helland-Hansen, Norway); Vulcanology, Michel-Lévy, France; Hydrology, Smetana, Czechoslovakia (Luetschg, Switzerland). The secretaries of Associations, in the same order (with new elections indicated in brackets), were: Perrier, France; Rothé, France; Wehrlé, France (J. Bjerknes, Norway); la Cour, Norway; Proudman, England; Malladra, Italy (Signore, Italy); Dienert, France (Frolow, France).

The administrative business of the Union included the election of Dr. D. la Cour (Denmark) as its next president; the continuance of the national subscriptions to the Union at the same rate as for the period 1933–36 (about £160 to £800 per annum according to the national population) and substantially the same division as before of the Union funds between the seven Associations; the adoption of new statutes together with new by-laws, in place of the existing statutes, and the acceptance of an invitation from the United States of America to hold the next General Assembly in Washington in 1939.

Structure of Proteins and of Certain Physiologically Active Compounds

By Dr. D. M. Wrinch, Mathematical Institute, Oxford

RECENT studies have discovered the fact that a number of classes of physiologically active compounds (for example, the carcinogens, the sterols and bile acids, the sex hormones, the heart poisons) have all a similar framework[1]. Two questions then arise. (1) What is the significance of this similarity of structure? (2) Why do these compounds which have certain similarities of structure possess physiological properties so different as those, for example, of the sex hormones and the cardiac poisons? In answer to these questions we suggest that for certain types of interaction with the organism it is necessary (though not sufficient) that a molecule possess an affinity for, in the sense of superposability on, some 'substrate' in the organism. This suggestion, which simply gives precise expression to an idea long since well established in physiological chemistry[2], accounts for the similarity of framework. The particular nature of the interaction may then be attributed to the degree of unsaturation (compare specially the carcinogenic hydrocarbons and cholesterol), to the occurrence of a lactone ring and to the occurrence and particular distribution of carbonyl, hydroxyl and methyl groups in the compounds in question.

In the course of an orderly search for some suitable substrate sufficiently widely distributed through the organism and yet possessing a common molecular surface pattern or mosaic, attention is naturally directed first to the proteins. More than any other chemical substance proteins have an inevitable connexion with living matter; wherever there is living matter there proteins are found; wherever there are proteins there is or was living matter[3]. Undeniably, proteins are connected with the physico-chemical changes which occur during the life of an organism. They form a more or less permanent part of it, since only under conditions of starvation are they oxidized to release the energy required to perform the work of the cell[4]. Furthermore, many facts belonging to protein chemistry (for example, the interchangeability of proteins as substrates for certain enzymes) suggest that proteins can possess a common surface pattern. For these reasons there is an inherent plausibility in postulating that the substrate whose mosaic is to have a geometrical affinity to the classes of compounds mentioned above is protein*.

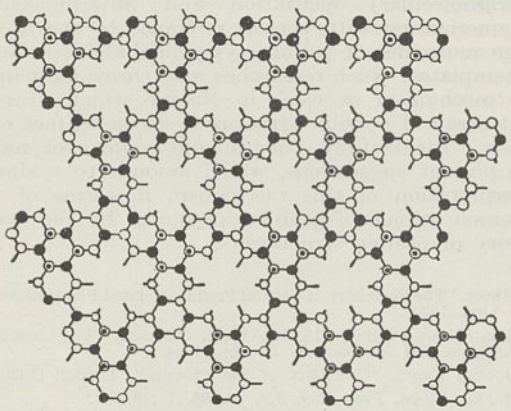

FIG. 1. The cyclol pattern. The median plane of the lamina is the plane of the paper. The lamina has its 'front' surface above and its 'back' surface below the paper.

● = N.
○ = C(OH), hydroxyl upwards.
⊙ = C(OH), hydroxyl downwards.
○— = CHR, direction of side chain initially outwards.
○– = CHR, direction of side chain initially upwards.

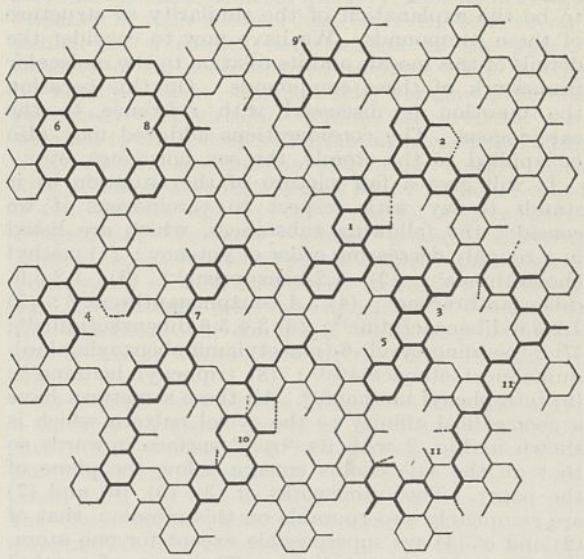

FIG. 2.

The fundamental fact about the structure of proteins is that they consist of condensations of amino (and imino) acid molecules. Leaving aside the intermediate stages, polypeptides or substituted diketopiperazines, which may or may not occur in biosynthesis, and which in any event yield an identical pattern by means of cyclization and polymerization respectively, we find that it is possible to construct a simple polycondensation pattern of the amino acids. This 'cyclol' pattern depends upon

* In a recent research on the effect of methyl cholanthrene on mouse fibroblasts *in vitro* (NATURE, **138**, 291; 1936), Hearne finds that this carcinogen induces chromosome pairing and chiasma formation in somatic cells. In view of the protein in the nuclear membrane and in the chromosomes themselves (see Wrinch, NATURE, **134**, 978; 1934. ibid., **135**, 788; 1935), this result affords some support for the suggestion that the 'substrates' upon which carcinogens act are protein in nature.

one and only one assumption, itself a simple extension of Fischer's classical hypothesis, namely, that amino acids can condense by means of single, double and triple peptide links. Given this assumption, the 'cyclol' theory of protein structure follows by means of purely logical and mathematical arguments[5]. The plane form of the cyclol pattern is shown in Fig. 1. Owing to the lævo character of all the amino and imino acids in proteins[6], the cyclol pattern is a dorsi-ventral lamina in the sense that from one surface all the side chains emerge, whereas the other surface is free from side chains. Here, then, is further evidence that it is possible for proteins with the most diverse chemical composition to share one common surface pattern, namely, that on the surface free from side chains. A number of the requirements of protein chemistry are thereby met; and the type of substance which is *a priori* most likely to be involved in reactions with the physiologically active compounds listed above, turns out actually to possess a common mosaic. Affinity with this mosaic then seems likely to be the explanation of the similarity of structure of these compounds. We have now to consider the details of this mosaic and its relation to the molecular framework of these compounds. On this occasion the question is discussed with reference to the carcinogens. The considerations adduced may also be applied to the sterols, the sex hormones, etc.

It will give a fair picture of the situation as it stands to-day with respect to carcinogens if we consider the following substances, which are listed in a roughly decreasing order of potency: (1) methyl cholanthrene[7]; (2) 1,2-benzpyrene[8]; (3) 1,2,5,6-dibenzanthracene[9]; (4) 3,4-benzphenanthrene[10]; (5) 1,2,5,6-dibenzacridine[10]; (6) 3,4,5,6-dibenzacridine[10]; (7) 2-(*p*-aminostyryl)-6-(*p*-acetylaminobenzoylamino)-quinoline methoacetate[11]; (8) triphenyl benzene[12]; (9) tetraphenyl methane[12]. All these structures have a geometrical affinity to the cyclol pattern which is shown in Fig. 2 with its 'back' surface upwards so that all the side chains emerge below the plane of the paper. The frameworks of (3), (5), (6) and (7) are completely superposable on this mosaic: that of (2) and of (4) are superposable except for one atom, as shown by dotted lines. The case of methyl cholanthrene is interesting, in that complete superposability can be obtained by including an imino acid residue in the cyclol pattern. Alternatively, the framework is superposable, as shown in Fig. 2, except for the distortion of the five-membered ring, shown by the dotted line. Triphenyl benzene is superposable to the extent of 21 of its 24 carbons: furthermore, it can attain this superposability in three different ways. The position with respect to tetraphenyl methane is rather different since this compound is not even approximately plane. In Fig. 2, (9) shows part of its skeleton: 14 of its 25 carbons are superposable in the cyclol pattern. Since this molecule is non-planar[13], the possibility of the superposition of these 14 atoms on the cyclol pattern requires that the cyclol pattern shall not be plane at that point, but take up an orientation in which two neighbouring diazine rings do not share the same median plane, but have median planes making the tetrahedral angle with one another. The affinity of (9) to proteins is therefore not to the plane cyclol pattern as shown in Figs. 1 and 2, but to the general three-dimensional cyclol pattern, which has already proved useful in devising structures for the globular proteins[14].

This preliminary study of the affinities of the carcinogens for the cyclol mosaic presents two points of interest. Evidently a structure may be partially or even wholly superposable on the cyclol pattern without possessing the phenanthrene nucleus. Further, since the cyclol pattern need not be planar, there is no reason to expect that all carcinogens are planar. The substance (9), far from being an anomaly, may be the first of a new type of non-planar carcinogens which have a geometrical affinity to the non-planar cyclol pattern.

The suggestion that ordinal similarity of molecular structures is a necessary (though not sufficient) condition for certain types of physiological interaction, and that the special nature of these interactions is then determined by special atomic groupings, is in good accord with phenomena belonging to many fields of physiological chemistry. As an example we cite the case of the specific polysaccharides of types I, II, III, IV pneumococcus, which are antigenic when coupled to a protein, although the antigenic reaction is specific to the polysaccharides[15]. We may suppose that the importance of the protein constituent resides in its superposability on a protein substrate, the nature of the action being conditioned by the polysaccharide. It is perhaps appropriate to direct attention at this point to the far-reaching consequences which are logically entailed if, as is now suggested, proteins of different chemical composition can yet possess a common surface pattern.

The geometrical relationship of the cyclol pattern and the framework of the physiologically active compounds mentioned above further suggest that proteins may be the seat of biosynthesis. We suggest that cholesterol and carotene, for example, are formed in the organism by superposition on a cyclol template. The 'ingredients' may be pictured as long carbon chains which on superposition cyclize as shown in Fig. 2 (see (10) for cholesterol and (11) for carotene) or possibly as shorter carbon chains which then join up intermolecularly.

It appears that there is an important field for experimental work in the study of the processes of (intramolecular) cyclization and (intermolecular) polymerization with special reference to the use of large molecules of various types, including proteins, as templates. Such researches may throw light upon the mechanism at work in Nature which, from a vast array of possible structures, selects in fact only a few. Incidentally, they should confirm or refute the present suggestions, which amount to a simple interpretation of this mechanism in terms of the common mosaic of proteins predicted by the cyclol theory of protein structure.

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[15] Morgan, *Chem. and Ind.*, **55**, 284 (1936).

Administration and Technology in Industry

IN a paper on "The Place and Function of the Administrative and Technical Worker in the New Forms of Economic Structure" before Section F (Economic Science and Statistics) of the British Association on September 14, Mr. S. W. Smith directed attention to the growth and change of personnel which have accompanied the changes in the structure of industry and in industrial practice and technique in the last thirty-five years, particularly since the War. The mechanization and rationalization of industry have been accompanied by a significant growth in the importance of the technicians and scientific workers and the administrative staff, with a simultaneous reduction in the significance and proportion of unskilled labour and of controlling and directing owners of business. The bulk of the reorganization and modernizing work involved in the transformation of industry has been carried out by the technical and administrative staffs, and their importance has been further enhanced by the marked tendency for the proportion of professional, technical and administrative staffs to increase steadily in proportion to the remainder.

In support of his argument Mr. Smith referred to figures from the 1930 Census of Production showing that the administrative staff in productive concerns increased by 12·3 per cent between 1924 and 1930, excluding all those employed in shops, wholesale houses, banks, insurance companies, etc. Compared with 1907, while the total of operatives fell from 6,493,129 to 6,417,514, that of the administrative, clerical and technical staff rose from 490,947 to 723,920. Between 1911 and 1931, wages paid in industry receded from 42·5 to 41 per cent of the total, whereas in the same period salaries increased from 12 to 24 per cent. Between 1921 and 1931 professional workers increased by nearly 21 per cent, the increase in clerical staff being even more striking. Throughout the motor industry, the electrical and radio industries, and all branches of chemical industry the professional, scientific, technical and administrative staff played a dominant role, and it may be said that large business owes its existence chiefly to them. In turn, large business has provided them with the best and most abundant opportunity for their knowledge and skill. Virtually they constitute a new class, the most significant products of modern technique in industry and commerce, and in factory or office everywhere they occupy key positions.

The efficient functioning of large-scale business, whether manufacturing or distributive, largely depends upon these workers, who not only supply initiative and active control but also a constant flow of new ideas and inventions. Much the same holds with public utility corporations and municipal enterprises. Mr. Smith directed attention to the displacement or substitution of company proprietors or directors by responsible public officials, and the stipulation that a director should hold no shares whatever in order to secure that his dominant concern should be the public interest.

These changes have led to the question of training for industrial administration receiving growing attention. In the Post Office, a training school has been established in connexion with its Engineering Department where probationary assistant engineers receive a course of instruction in administration and finance. The conversion of potential proprietors into salaried managers and administrators also means that the speculative outlook of profit-seeking persons is replaced by the professional outlook with its prime interest in the efficiency of the work for its own sake. Since the salaried technician or administrator when reasonably and adequately paid tends to be interested in his work for its own sake, the functional outlook tends to replace the profit-seeking motive, care of the public interest and the spirit of service or trusteeship that of self-seeking or proprietorship.

This expansion of the administrative, technical and managerial sections of industry, with its increased stability of their income, has, however, been accompanied by a serious deterioration in the general security of all such salaried workers. The advent of unemployment among such workers who had previously been virtually immune has probably contributed to the widespread establishment among them of protective associations and trade unions, some fifty of which were represented at a Conference called a year or two ago by the National Federation of Professional Workers. Under present industrial tendencies, this increased precariousness and economic uncertainty of salaried workers is likely to continue, and its existence must be recognized in considering the significance of the place which administrative and technical workers now occupy both in industry and in society.

At a subsequent session on business administration, a number of these questions were again raised in Mr. C. A. Lee's paper on "Some Problems of a Small Manufacturing Business". The great asset of the small firm, Mr. Lee considers, is the way in which the closer contact possible with the head makes it possible for his personality to be felt right through the concern. This in itself is an important factor in developing a team spirit among the staff, which is just as important in a small as in a large firm for securing real co-operation, receptivity to new methods and keen interest in work. Moreover, the team spirit constitutes an effective check on slackness and grousing. Good leadership is most important and should endeavour to inspire the confidence that all concerned will be fairly treated, adequately paid and enjoy good working conditions. It is essential that the responsible staff should feel free to express ideas and have opportunity to advance. The problem of promotion may easily present real difficulty in a small firm. In regard to efficiency, while the small manufacturer cannot maintain the staff of experts employed by the larger firms, the use of outside consultants is a great help in introducing new ideas, and provided effective co-operation is secured with the staff, may be of real advantage in spite of the consultant's lack of knowledge of the particular business. In the discussion which followed, Mr. R. J. Mackay referred to the success which has attended the autonomous groups system described by M. H. Dubreuil before the Section in 1934.

The paper by Mr. E. S. Byng which followed discussed the claims of administration to be considered a definite profession, involving a special technique

and requiring a systematic scheme of education. Empirical methods of approach can no longer be considered adequate when our economic units are so large and their administration so complex, and it has become necessary to distinguish between the trained administrator who adopts a scientific approach to his problems, and the man who continues on rule-of-thumb methods. Administration may be defined as the co-ordination and control of all the specialized activities necessary to the effective operation of an industrial or other undertaking. Administration and specialist functions are closely interwoven in the senior positions of an industrial undertaking. While, for example, the managing director may be regarded as exercising 90 per cent administrative and 10 per cent technical functions, the works manager 66⅔ per cent administrative and 33⅓ per cent technical, the sales manager 60 per cent technical and only 40 per cent administrative, it is surprising how far down the scale some proportion of administrative function is involved.

The chief characteristics of modern industrial administration may be summarized as: functional division and devolution of responsibility, involving specialization and simplification; co-ordination of activities, involving the generation of the team spirit on a large scale; and the substitution of fact analysis for guesswork, involving planning, costing and budgetary control. The impact of economic forces has driven industrialists to seek higher efficiency through the improved technique of specialists in all these departments. Their next problem is to bring about a parallel improvement in the technique of administration itself.

Mr. Byng referred to the way in which the responsibility of the administrator has been enhanced by specialized research into the conduct of industry, and stressed the importance of advances in industrial psychology and the study of human relationships. If the art of persuading men to work willingly and harmoniously is lacking, the real effectiveness of the undertaking is seriously impaired, and even complete failure may ensue. Sound laws of administration cannot be laid down without a clear understanding of human motives and desires embodying the characteristics of the group-mind, the effect of tradition, the response to varying incentives, the real causes of unrest and the emotional reactions to regulations and discipline. Accordingly, the responsibilities of the administrative function for the efficient development of industrial and commercial enterprise, for the effective use of capital and labour, and for the creation of means by which the increased wealth due to technological improvements in industry can be utilized for the greatest benefit of all concerned, carry social and economic consequences of national and indeed international importance.

Mr. Byng also discussed the question of education for administration both through such organizations as the Institute of Industrial Administration and within the ranks of industry itself. Finally, he urged that administration may justly claim to be a vital factor in industry and to offer an almost unlimited field of usefulness for the highest grades of intelligence. Our industrial future depends largely upon our methods of selecting and training administrators, and the general recognition of the high function they are called upon to perform.

New Ultracentrifuge Installation at the Lister Institute

ON Tuesday, September 29, the Governing Body and the Director of the Lister Institute entertained Prof. The Svedberg of Uppsala and a number of interested physicists, biochemists and biologists on the occasion of the completion of the new ultracentrifuge plant. In welcoming the guests, Prof. J. C. G. Ledingham explained that in anticipation of Prof. Svedberg's visit to London on his way home from the Harvard celebrations, every effort had been made to put the finishing touches to the new installation. Dr. McFarlane, Lister Institute fellow in biophysics and a former pupil of Prof. Svedberg, had been almost entirely responsible not only for the design of the building to accommodate the new plant, but also for the supervision of the lay-out and assembly of all the accessory connexions, electrical, optical, refrigerating, etc., carried out by the Institute's engineering staff. Throughout the whole work, he had enjoyed the constant advice amd co-operation of Prof. Svedberg. The total cost of the installation, including the new building, was about £7,000, of which sum the Rockefeller Foundation had most generously contributed £3,400 in defrayment of the cost of the new machines.

The new laboratory is specially designed and equipped for investigations into the physical nature of very small particles, particularly protein molecules, but it is hoped also to extend its use to the study of the less well-defined entities such as viruses phages and antibody complexes.

The ground floor is largely taken up by two ultracentrifuges and their auxiliary machinery. Both machines, which were made in the workshops of the University of Uppsala to the design of Prof. Svedberg, have optical arrangements which make it possible to observe and photograph the contents of the rotating cell.

The smaller of the two machines is called the equilibrium centrifuge and is used for the determination of absolute particle size or weight. It runs at speeds up to 18,000 r.p.m. and usually for several days and nights continuously. The particles have then ceased moving, and a state of sedimentation equilibrium is set up, which allows of the calculation of absolute size from the final photograph.

The larger machine generates much greater centrifugal forces, up to half a million times gravity, and serves to throw down even the smaller protein molecules completely in a few hours. It is used to measure the sedimentation velocity constant of pure proteins and of the components of a mixture. In the case of native protein mixtures, such as blood serum, it is possible to centrifuge these without previous chemical treatment and to determine from the photographs the concentrations in which the component proteins are present.

The machine comprises a chrome nickel steel rotor of 7 in. diameter rotating inside a massive steel housing from which the air is evacuated and into which hydrogen is conducted at low pressure. The rotor is driven by high-pressure oil on the turbine principle, and the oil is also used to maintain the rotor at a constant low temperature. The usual speed is 60,000–70,000 r.p.m., and elaborate underground foundations are necessary to prevent the transmission of vibrations to the optical system. Owing to the position of the Lister Institute on a reclaimed bank of the Thames, it was necessary to drive piles to a depth of 40 ft. to support these foundations. The centrifuge is entirely controlled from an adjacent room in which temperature, speed, oil pressure, vacuum pressure, hydrogen pressure, etc., are measured and regulated with great accuracy. Photographs are taken every ten minutes through a window in the wall of the control room. Monochromatic light isolated from the mercury arc is used and the wave-length is chosen to suit the light absorption of the protein.

On the upper floor a roomy laboratory is provided for general chemical and physical investigations. A smaller room which is maintained at a constant temperature is intended for measurements of *p*H, conductivity, refractive index and cataphoresis constants. For measurements of the latter an optical system is set up, similar to those on the centrifuges, and this enables photographs to be taken of charged particles migrating in the electric field at a rate which is proportional to their charge. Two modernly-equipped dark rooms are provided, and in another room examination of plates is carried out and calculations made incidental to the various techniques in use.

The rooms in the new laboratory are supplied with compressed air, distilled water and refrigerated water, and are all electrically linked to a central distribution board from which they may receive various electrical supplies, including constant voltage D.C. of low and high voltage, and A.C. of variable frequency. Any room can communicate electrically with another through the main distribution board, and in this way remote electrical measurements may be taken rapidly without the need for transporting complicated apparatus.

Science News a Century Ago

Clarke's Magneto-Electric Machine

IN the *Philosophical Magazine* of October 1836 is a letter to the Editor from E. M. Clarke, of 9 Agar Street, West Strand, London, in which he describes his magneto-electric machine. The letter begins: "From the time Dr. Faraday first discovered magnetic electricity to the present, my attention as a philosophical instrument maker, has been entirely devoted to that important branch of science, more especially to the construction of an efficacious magnetic electric machine, which after much anxious thought, labour and expense I now submit to your notice".

Clarke's machine was designed primarily for physiological purposes. It had a permanent magnet of six laminations mounted vertically and an armature with soft iron cores wound with insulated wire, which could be revolved rapidly past the sides of the magnet poles. With what he called his "intensity" armature, which was wound with 1,500 yards of fine insulated copper wire, the effect, he said, produced "in the nervous and muscular system is such, that no person out of the hundreds who have tried it, could possibly endure the intense agony it is capable of producing; it is capable also of electrifying the most nervous person without giving him the least uneasiness". With his "quantity" armature, which was wound with fifty yards of thick copper bell wire, he could make the various experiments performed with a single pair of voltaic plates and could produce large and brilliant sparks by the light of which a person could read small print.

The Aurora Borealis of October 11, 1836

ACCORDING to *The Times*, shortly after 8 o'clock of the evening of October 11, 1836, "the Metropolis and its suburbs for miles around was thrown into a state of the greatest excitement by the northern hemisphere assuming a most awful fiery appearance, which seemed to indicate the existence of some dreadful conflagration in the north portion of the Metropolis. . . . Many of the fire engines were put into motion, and after scouring the northern parts of the City and suburbs in search of the supposed fire, it was at last discovered that the appearance of the sky had been caused by one of the most splendid of those remarkable phenomena known as the *Aurora Borealis*, or Northern Lights.

"From persons who had the opportunity of witnessing the magnificent spectacle from elevated situations, we understand there first appeared a large luminous arch, extending nearly from north to south, from which streamers appeared, very low. . . . Suddenly the whole hemisphere was covered with them, when the intensity of the light, the prodigious number and the volatility of the beams, the grand intermixture of all the prismatic colours in their utmost splendour, variegating the glowing canopy with the most luxuriant and enchanting scenery, afforded an awful, but at the same time the most pleasing and sublime spectacle in nature. . . ."

Braithwaite's Steam Floating Fire Engine

ONE of the most active mechanical engineers of a century ago was John Braithwaite (1797–1870), who with Ericsson constructed the locomotive *Novelty* which competed at Rainhill with the *Rocket*, and who with Vignoles laid out the Eastern Counties Railway. With Ericsson he constructed the first steam fire engine. In the *Mechanics' Magazine* of October 15, 1836, he described his "Steam Floating Fire Engine" for use on the River Thames. Though the superiority of the steam fire engine over hand-worked engines had been demonstrated at several fires in London, the London Fire-Engine Establishment, supported by various insurance companies, still clung to hand-worked engines.

The fire float of Braithwaite was a wrought iron boat 80 feet long, 13 feet wide drawing about 2 feet of water. It was fitted with a boiler "on Braithwaite and Ericsson's patent principle" and an engine of 30 horse power giving the craft a speed of about 9 knots. The engine could be coupled by gearing to either the paddle shaft or to double-acting pumps capable of discharging 4–5 tons of water per minute. In his communication to the *Mechanics' Magazine*, Braithwaite said that in spite of the various demonstrations he had given, the insurance companies declined to adopt his engine and "as things at present are I am minus about £3,500 by my invention".

Societies and Academies

Paris

Academy of Sciences, September 7 (*C.R.*, **203**, 505–524).

EDOUARD CHATTON and FÉLIX VILLENEUVE : The sexuality and evolutive cycle of *Siedleckia* based on the study of *S. Caulleryi*, hologametogenous and blastogametogenous Sporozoa.

N. A. SLIOSKINE : The rotation of a cavity filled with a viscous liquid.

PAUL MULLER : The Paris-Strasbourg gravimetric relation.

ANDRÉ BOUTILLIER : Study of the dilatometric anomalies due to external forces in copper aluminium alloys containing 7–16 per cent of aluminium.

HENRY GAULT and LOUIS ANDRÉ GERMANN : 2-Methylene-1-butanol-3-one.

RAYMOND FURON : The existence of a Ural axis determining the structure of the Iranian Plateau.

JACQUES RISLER : The antiseptic power, either immediate or after prolonged action, of essential oils. The bactericidal power of essential oils can be prolonged by the addition of substances named 'abiotaxines'. Thus the addition of benzoin to oil of thyme prolongs the antiseptic action from 28 days to four years.

ANDRÉ LWOFF and MME. MARGUERITE LWOFF : The nature of the factor V.

HENRI BERRIER : The influence of fasting in the tadpole of *Discoglossus pictus* on the proportion of substances acting as plant auxins.

September 14 (*C.R.*, **203**, 525–548).

EDOUARD CHATTON and MLLE. SIMONE BRACHON : A protistan, parasite of the ciliate *Fabrea salina* : *Gregarella fabrearum* and its evolution.

ALEXANDRE GHIKA : The development in series of orthogonal functions, of analytical functions of two complex variables.

MARCEL MENDES : The rotation of the heterogeneous ellipsoid studied by means of Lamé functions.

DOUCHAN AVSEC : The formation of convection vortices, in a gaseous layer, with thicknesses of the order of some centimetres.

J. VALENSI and J. SOBIESKI : Tubes with mercury vapour at high pressure for illuminating smoke in aerodynamical studies. Description of a tube which can replace advantageously a carbon arc lamp in certain classes of photography.

THÉODORE V. IONESCU : The properties of an electron which rolls without slip and the radius of which varies inversely as the velocity.

JULES FARINEAU : The K spectrum and conductivity electrons of solid and liquid aluminium.

HORIA HULUBEI : Measurements of the L spectrum of radium (88).

JEAN CHEYMOL : Verbenalol, aglucone and verbenaloside.

BORIS EPHRUSSI, C. W. CLANCY and G. W. BEADLE : The influence of the lymph on the colour of the *vermilion* eye in *Drosophila melanogaster*.

MAURICE MATHIS : The diagnosis of yellow fever by intracerebral inoculation of the blood of the patient into white mice. Inoculation into *Macacus rhesus* has hitherto been the only certain test for yellow fever, but these animals are becoming more difficult to obtain. It is now shown that the macacus can be replaced by white mice.

Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 7 ; 1936).

P. STROOBANT : Observation of the eclipse of the sun on June 19, 1936, at the Astronomical Institute of the University of Brussels.

L. GODEAUX : Cyclic involutions of the third order belonging to an algebraic surface.

F. SWARTS : (1) Substitution of fluorine for other halogens with the aid of mercurous fluoride and the iodide (preparation of methyl fluoride). (2) Decomposition of cyclohexyl bromide in the presence of mercuric bromide and the formation of polymers of cyclohexene.

F. H. VAN DEN DUNGEN : *A propos* of a theorem in statics due to M. Giovanni Lampariello.

J. MARIANI : The principle of subjectivity and the theory of gravitation.

J. JAUMOTTE : Variation of the wind with altitude.

P. GILLIS : A class of partial differential equations.

P. BOURGEOIS and J. F. COX : The conditions of observation of the minor planet (1936 *CA*) = Adonis.

P. BURNIAT : Note on some canonical surfaces and on the surfaces of genus one.

M. LINSMAN : The singularities of the elementary curves in finite geometry (2).

B. ROSEN and F. BOUFFIOUX : Contributions to the study of the molecular spectra of the sulphur group.

E. MIGEOTTE and E. HOGE : Observation of the eclipse of the sun on June 19, 1936, made with the equatorial of the Cointe Observatory.

Moscow

Academy of Sciences (*C.R.*, 2, No. 7, 1936).

K. MARDŽANIŠVILI : Simultaneous dissolution of whole numbers into m-th and n-th potentials.

L. SRETENSKIJ : Determination of resistance to rolling of a vessel moving on the surface of water of finite depth.

G. ČELINCEV : Organic derivatives of potassium and their role in organic synthesis.

D. MIRLIS and D. DERIBAS : Synthesis of tanning substances from carbohydrates.

V. DERWIES : Genesis of the magnetite deposits of the Gora-Blagodat in the northern Urals.

B. ASTAUROV : New data on artificial parthenogenesis in the silkworm (*Bombyx mori* L.). Individual capacity for parthenogenesis is a hereditary character, probably due to a small number of genes having specific action.

B. ISAČENKO : Corrosion of concrete. There is some evidence of microbiological action on submerged concrete due to fungi (*Oospora Candida* and *Sporotrichum*).

A. A. RICHTER : An absorber of carbon dioxide for currents of atmospheric air.

V. KATUNSKIJ : Movement of growth-promoting substance and the growth of plants in an electric field. (Contribution to the study of electro-cultivation of plants.) A negative potential inhibits the movement of growth-promoting substance in the basipetal direction, while a positive potential stimulates that movement.

N. KONSTANTINOV : The vernalization of tree-cotton.

T. S. RASS : Types of fish-eggs and their bearing on the classification of fishes.

(*C.R.*, 2, No. 8, 1936).

A. P. DIETZMANN and S. A. CUNIKHIN : Classes and centre of a finite group.

S. NIKOLSKIJ : Linear equations in metrical space.

P. A. WALTER : A current through a hydraulic grid with rounded lobes of small curvature.

A. P. ILYINA : Stratigraphy and fauna of the tertiary sediments of the western coast of Kamchatka.

W. A. ENGELHARDT and M. N. LJUBIMOVA : The double mechanism of adenosine triphosphate stabilization in cells. (1) Reticulocytes.

W. A. ENGELHARDT and A. A. BAJEV : The double mechanism of adenosine triphosphate stabilization in cells. (2) Nucleated avian erythrocytes.

A. I. GREČUŠNIKOV : Toxins of rust (*Puccinia*). The active principle of the toxin consists of two simple compounds, namely, ammonia and urea.

I. A. STEFANOVSKIJ : Influence of environmental factors on immunity of wheat. Retardation of sowing date increases the incidence of brown rust.

V. V. POPOV : The potential ability of various cells for lens development.

I. A. RUBTZOV : A new Simuliid species (*Simulium oligocenicum*, sp.n.) from amber.

(*C.R.*, 2, No. 9, 1936).

I. VINOGRADOV : New results concerning the distribution of fractional parts of a polynomial.

L. V. KANTOROVIČ : The elements of the theory of functions of a real variable with values belonging to a semi-ordered linear space.

V. GAVRILENKO : Distribution of communicated velocities in turbulent uniform currents of liquid.

N. T. FEDOROV and V. I. FEDOROVA : The problem of the curve of the spectral sensitivity of the eye.

V. RASUMOVSKIJ : Polarity and tautomerism.

N. I. KOBOSEV, B. V. JERUFEJEV and V. M.SAVINA : Hydration of aluminium nitride by active hydrogen.

A. E. FERSMAN : Application of *VEK*'s in geochemistry.

V. A. NOVIKOV : The influence of the intensity of illumination on the development of the cotton plant. Cotton possesses a very wide range of physiological plasticity as regards intensity of illumination.

A. MACHOTIN : Reduction phenomena in the morphology of the adult moth *Operophthera brumata* L. Loss of wings in the female leads to a greater development of the musculature of extremities. Reduction of digestive tract in the male is accompanied by the transformation of the stomach into an aerostatic apparatus.

J. IEŽIKOV : Some considerations on the types of development of Metazoa from the egg.

Vienna

Academy of Sciences, July 2.

MAX PESTEMER, TRUDE LANGER and FRIEDRICH MANCHEN : Influence of substituted radicals on the ultra-violet absorption of benzene chromophores, both simple and conjugated with double bonds.

K. W. F. KOHLRAUSCH : Studies of the Raman effect (58). Raman spectrum of organic substances (nitrogenous substances : (1), simple amines).

L. KAHOVEC and K. W. F. KOHLRAUSCH : Studies of the Raman effect (59). Raman spectrum of organic substances (nitrogenous substances : (2), amino- and oxyacetic acid and its esters).

OTTO REDLICH and WALTER STRICKS : Raman spectra and vibrations of di- and tetradeuterobenzene.

L. KÜCHLER and F. PATAT : Photochemical conversion of *o*-nitrobenzaldehyde to *o*-nitrobenzoic acid.

GABRIELE ROGENHOFER : Action of growth-promoting substances on bark formation in woody shoots.

L. PORTHEIM : Action of β-indolylacetic acid on plants (1).

KURT LOHWAG : (1) A useful method of macerating wood tissues. (2) Preservation of the colours of the ordinary wood reaction.

JOSEF KISSER and YOSHIO KONDO : Microchemical test of divalent and trivalent phenols by means of spot reactions.

JOSEF MATTAUCH : Measurements with a new type of mass-spectrograph.

ELISABETH RONA and ELISABETH NEUNINGER : (1) Artificial radioactivity of thorium. An actinium isotope of 42 hours half-period is formed on bombarding thorium with neutrons. (2) Artificial radioactivity of thulium. $^{170}_{69}$Tm, formed by bombarding thulium with slow neutrons, has a half-period of $4 \pm \frac{1}{2}$ months.

STEFANIE ZILA : Development of a photographic method for the study of proton beams. Methods of sensitizing plates for the registration of protons are described.

ERNST SCHÄFLER : Effect of γ-rays on desensitized photographic plates.

KASIMIR GRAFF : Observation of the total solar eclipse of June 19, 1936.

ROBERT WILLHEIM : The Pasteur-Meyerhof reaction in cancer glycolysis.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 12

UNIVERSITY COLLEGE, LONDON, W.C.1, at 5.0.—Dr. R. J. Lythgoe : "The Physiology of Vision" (succeeding lectures on October 19, 26, November 2, 9).*

Tuesday, October 13

SOCIETY FOR THE STUDY OF INEBRIETY AND DRUG ADDICTION (at the Friends' House, Euston Road) at 4.—Prof. D. K. Henderson : "Alcoholism and Psychiatry" (Norman Kerr Lecture).

UNIVERSITY COLLEGE, LONDON, W.C.1, at 5.—Dr. C. Reid : "The Endocrine Organs in relation to Metabolism" (succeeding lectures on October 20, 27, November 3).*

ILLUMINATING ENGINEERING SOCIETY (at the Lighting Service Bureau, 2 Savoy Hill, W.C. 2), at 5.30.—A. Cunnington : Presidential Address.

Thursday, October 15

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).
At 2.30.—Sir Philip Dawson : Presidential Address.
At 3.30.—Prof. Franz Fischer : "Production of Synthetic Motor Spirit" (Melchett Lecture).

KING'S COLLEGE, LONDON, W.C.1, at 5.30.—Dr. S. J. Davies : "Injection and Combustion in Oil Engines" (succeeding lectures on October 15, 22, 29, November 5, 12, 19).*

BRITISH INSTITUTE OF RADIOLOGY, at 8.—Prof. J. A. Crowther : "Physics and Radiology" (Presidential Address).

NATIONAL SMOKE ABATEMENT SOCIETY, October 14–17. Annual Conference to be held in the Science Museum, South Kensington, London, S.W.7.

SOCIETY OF CHEMICAL INDUSTRY (at University College, London, W.C.1), October 15–16. Conference on Automatic Control in Industry.

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Vol. 56, Part 2, Nos. 9 and 10: The Dynamics of the Formation of Cone-sheets, Ring-dykes and Caldron-subsidences, by Dr. E. M. Anderson; Note on Fracture, by Dr. Harold Jeffreys. Pp. 128–163. 3*s*. Vol. 56, Part 2, No. 11: The Relation of the Pituitary Gland to Muscle Creatine. By B. G. Shapiro and H. Zwarenstein. Pp. 164–168. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [89

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 8: i. The Concentration of Solutes in Sap and Tissue, and the Estimation of Bound Water; ii. Further Studies on Transport in the Cotton Plant, 5: Oxygen Supply and the Activation of Diffusion. By T. G. Mason and E. Phillis. Pp. 437–499. 2*s*. 6*d*. Series A: Genetics. No. 13: Some Observations on the Inheritance of Form and Size in Asiatic Cottons. By J. B. Hutchinson. Pp. 399–410. 2*s*. 6*d*. (London: Empire Cotton Growing Corporation.) [89

University of London: University College, Faculty of Medical Sciences. Session 1936–1937. Pp. vi+285–320+xiii. (London: University College.) [99

The British Academy. Presidential Address, July 1936. By J. W. Mackail. (From the *Proceedings* of the British Academy, Vol. 22.) Pp. 12. (London: Oxford University Press.) 1*s*. net. [109

Queen Mary College (University of London). Calendar, Session 1936–1937. Pp. 284. (London: Queen Mary College.) [119

Report of the Commission appointed to Enquire into and Report on the Financial Position and System of Taxation of Kenya. (Colonial No. 116.) Pp. vii+282. (London: H.M. Stationery Office.) 9*s*. net. [149

The Royal Technical College, Glasgow. Calendar for the One Hundred and Forty-first Session, 1936–1937. Pp. 490+xix. (Glasgow: Royal Technical College.) [169

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1689 (2128): Contribution of Body and Tail of an Aeroplane to the Yawing Movement in a Spin. By H. B. Irving, A. S. Batson and J. H. Warsap. Pp. 16+26 plates. (London: H.M. Stationery Office.) 2*s*. net. [169

Ministry of Agriculture and Fisheries. Collected Leaflets No. 5: Birds. Pp. iv+86. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [179

How Allotments could be made an Amenity Asset to the Community. By Lady Allen of Hurtwood; Designs for Hut Units and Community Centre, by William Tatton Brown. Pp. 22. (London: The Housing Centre.) 3*d*. [179

Engineers' Study Group on Economics. Interim Report on the Design of a Family Budget with Special Reference to Food; Presented to a Joint Meeting of the Engineers' Study Group and the Association of Scientific Workers held on March 31, 1936, in the Rooms of the Royal Society of Arts. Second and revised edition. Pp. 48. (London: Engineers' Study Group on Economics.) 1*s*. 6*d*. [189

Birkbeck College (University of London). The Calendar for the Year 1936–37 (114th Session). Pp. 275. (London: Birkbeck College.) [189

Other Countries

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