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Citizenship

AT the recent conference of the Association of Teachers in Technical Institutions, Mr. W. E. Park referred in his presidential address to a report on training for citizenship for students in technical institutions which had been prepared by his Association in conjunction with the Association of Principals of Technical Institutions and the Association of Technical Institutions. The report has just been issued, and is one which we believe ought to be regarded as of first-class importance.

The reasons for our belief are not far to seek. A glance about the world reveals its present discontents with an uncomfortable vividness. The old values which seemed once so secure are fading. Human organizations, which seemed but a few years ago to be leading, however slowly, to sane and rational ends, are crumbling. Over-production on one hand and even starvation on the other become more sharply defined. Political ideas appear charged with a newer and more emotional violence. The dream of a world-State shatters down to a grim reality of nations self-contained, self-striving and living in a fear-haunted hostility which keeps us on the brink of unimaginable dangers. If we are not, at the moment, living under the actual threat of war, we are daily made aware of rearmament and the need to be prepared for what can be little else than the crash of civilization as we know it. Yet, in spite of the distinguished writer who informed us with grim curtness that we are witnessing a race between education and catastrophe, it would seem, in Great Britain, at any rate, that the world of education moves on with calm serenity and is by no means convinced that, if it neglects the problems which none of its students can ultimately

avoid, it neglects a vital duty. Whatever we may think of dictator countries, they have at least learned to use the machinery of their schools. They have infused education with their own enthusiasms and made it aware of its part in the life and work of the community.

Sir Ernest Simon, chairman of the Association for Education in Citizenship, has summed up the aims of that education under four heads: a sense of social responsibility; a love of truth and freedom; the power of clear thinking in everyday affairs; a knowledge of the broad political and economic facts of the modern world. Those aims are ambitious, and we would hesitate even to attempt to sketch the means whereby they might be attained. We know perfectly well that those responsible for any kind of school can point to their time-tables and syllabuses and ask where and how they are capable of addition. They can say, broadly, that the aims are inherent in their present work. But the problem has an urgency which will not permit it to be so easily dismissed. The manipulation of time-tables and syllabuses is a matter for experts, and none would be so bold as to say that it may not be somehow used to make education that very real thing—*adaptation to environment*. Inherent qualities, too, need more discussion than the phrase sometimes permits. We have long since given up the belief that training in one subject necessarily gives facility to deal with another. If that were so, we should find that our specialists were invariably wise and their judgment, outside their specialist field, invariably sound. But we know that is not the case. The specialist in physics cannot necessarily be regarded as being free from prejudice, emotion and even ignorance when he is asked to make a judgment

on the League of Nations or the need for tariff reform. Clear thinking, in short, cannot be transferred from specialist subjects to others with which the voter has to deal in everyday life.

Whatever may be done in other fields of education, then, it is clear that those concerned in technical education are to be encouraged in their attempt to view the problem of education for citizenship from the point of view of their own work; for it is a task which presents the utmost difficulties when any *direct* method of teaching the subjects which citizenship may include is attempted. Naturally, if and when other branches of education take up those subjects, it is a task which will become correspondingly easier.

A large body of the students of technical institutions are those who take part-time courses. They are engineers, chemists, builders and the like, who are already in employment. Since they attend courses on some three evenings per week, and since they have to undertake homework in addition, and since their work is directed to the attainment of some recognized professional or industrial qualification, it is difficult to see how it can be possible to secure their attendance for additional, and, at first sight, unrelated subjects. For these students there is the possibility of the 'indirect' method. If education for citizenship means training the individual for his relationship to the various communities on which he impinges, it is certainly within the bounds of possibility—to put it no higher—that specialist subjects could be used by skilful teachers so that their backgrounds, contacts and relationships could be shown in the everyday world. The discussions and debates of students' societies, too, could be used. One imagines, for example, engineering and commercial students dealing with problems of production and distribution—under happier titles, perhaps—and arriving at conclusions concerning duties and relationships which normally they might miss.

For full-time students we hope more can be done. In their case it ought to be possible to apply the 'direct' method. The introduction of studies of the social sciences, the structure of government, modern political and industrial problems would, in our opinion, be of immense value in attaining the ends we have in mind. It is not for us here to suggest the precise subjects, their method of treatment or their particular place in particular curricula. It may be that the use of daily papers—with a view to comparison of opposing views on a single issue which are so

constant a feature of our modern daily Press—will take the place of the more orthodox text-book. (Such a method would, at least, train students to sift evidence and arguments for themselves rather than be swayed by the prejudice of partisan announcements.) It may be that local circumstances could be used to demonstrate problems of town-planning, means of transport, food supply, organization of community life, local and central government. Whatever the method, if an active interest in the social and political structure can be developed, the first step towards attainment of the aims of citizenship will have been secured.

It may be objected that this kind of teaching involves a danger of bringing politics into education. We would reply that, if a scientific approach to social and political problems be not taught, young people will be left unprotected, both now and in later life. Which is the greater danger?

We would make it very clear, even to the point of what may appear unnecessary reiteration, that we have no wish to make dogmatic suggestions as to subjects or to their treatment. It is desired only to emphasize that the social sciences must, in some way, be made to keep pace with the other sciences, which are setting expected, as well as unexpected, problems to our civilization. Articles in these columns from time to time have underlined the fact that, in spite of the advances of science and the obvious advantages which these have brought to us, we stand in the face of vast dangers all of which point urgently to the need of adapting our social life to the new and changing environment which men's activities have produced. The technologist and the scientific investigator should not be allowed to work in specialized compartments with no picture of how their work is related to the rest of the community. For want of a better name, we call the presentation of that picture 'citizenship', which Aristotle saw as "the most synthetic of sciences" and, as a practice, "the most architectonic of the Arts". His notion of civics was expressed under the four types of co-operation between the labour of the people, the public functions of citizens, the meditations of philosophers, and the efforts of teachers. It is a notion which we moderns, in our present dangers, should not neglect. For that reason, we welcome the publication of the report prepared by the three technical associations, and we look forward to its implementation in no matter how experimental a form.

Man and the Machine Age

Die Tragik des technischen Zeitalters
Mensch und Maschine im 19 Jahrhundert. Von
Otto Veit. Pp. 226. (Berlin: S. Fischer, 1935.)
n.p.

THE book under notice deals with a problem which has become very familiar to the German philosophers, sociologists and others since the days of Nietzsche. To put it very briefly, it comes down to this: the victory of rationalism, materialism, liberalism, individualism, and the achievements of the 'technical age' which originated from the victory in question, have become a fatal gift for the human race. It is true that the introduction of machinery into productive processes enabled the population to grow more rapidly and to be supplied with material goods more abundantly than ever before; but, at the same time, there opened a wide gulf between the 'objective' and the 'subjective' culture. Mankind has become richer in material wealth; man has become poorer.

Strange as it may seem, this judgment is justified in regard not only to man's emotional but also to his intellectual qualities; the philosopher who commanded all the knowledge of his time and was able to lift it up on a higher plane has been supplanted by the specialist who confines himself to a more or less narrow sphere of scientific comprehension. The political and economic freedom for which our forefathers fought so enthusiastically has changed into a universal dependency; the maintenance of liberal institutions in some major imperialistic countries does not alter this fact, but makes it still more impressive.

Finally, liberty of thought has become a rather negative character; we know the chains from which we are free (or from which we desire to be free), but we do not know exactly for what purpose we are free. Religious dogmas have lost that influence over the human mind they formerly exerted; the same fate has befallen the belief in reason, freedom, humanity and progress, which seemed to replace the religious creeds in the period of the bourgeois revolutions. This intellectual development inevitably results in a radical relativism which may discuss every thinkable opinion without taking sides with or against any one of them, and in scepticism and nihilism.

Two roads widely differing from each other seem to lead out of the cultural crisis; the first of them was indicated at the end of the eighteenth and beginning of the nineteenth centuries by thinkers like Burke in England, de Bonald, de Maistre, Chateaubriand in France, Adam Müller in Germany. These authors held the view that not the rational analysis but the somewhat irrational intuition ought to be regarded as the supreme method of scientific research; they placed emphasis on the fact that the genuine rights of the community are superior to those of the individual; they responded to the liberal admiration of progress and future with their worship of the past, the Middle Ages in particular. Consequently, they opposed the destruction of the traditional technique by modern machinery; they wanted the application of the latter to be kept down so far as possible, if not prohibited altogether.

The second attempt at a solution of the crisis has been made by socialism. The socialists did not lag behind the romanticists in acknowledging the damages inflicted upon culture by the bourgeois revolution. But the romantic criticism is reactionary and therefore, after all, it remains hopeless; the socialists, on the other hand, try to overcome the capitalist society in a progressive manner; they do not base their verdicts on the past but on the future. The socialists demand that those regions of social life which are centred upon technique and economics ought to be organized as rationally as possible; the predominant claim of socialism, namely, the replacement of private ownership in the means of production by common ownership, means in reality that the principle of rational organization which—under capitalism—is necessarily restricted to the individual factory or trust, is to be extended over the whole field of economic relations. Nevertheless, socialist rationalism is not an end in itself; the underlying motive is the settled conviction that technique and economics, if they are to be made to serve man instead of being served by him, form the appropriate foundation of a 'realm of real freedom' as it has been called by Marx.

It is very characteristic of the book under notice that Veit accepts neither the romantic nor the socialist solution. As regards his attitude towards the 'romantics', he is in accord with the vast

majority of the philosophers in fascist countries, who are in agreement upon many points with the feudal and clerical enemies of the bourgeois revolution but, at the same time, do not become 'romantics' in the strict or proper sense of the word. It is obvious why. The romantic flight into the Middle Ages, the veneration of the feudal monarchy, the nobility, the church and the corporations, have never been anything else but a counter-move against the use of liberal capitalism; and even in this respect their practical significance was limited to the period when modern technique and large-scale production were at their very beginning. Such currents like national socialism (or fascism in general) have sometimes been regarded as a set-back into a precapitalist state of society from which the present civilization is to be protected. People who argue along these lines are inclined to confound the ideological veil with the social reality that the former has to cover. National socialism, in the very interests of rearmament and imperialistic expansion, is forced to develop the applied sciences; and the big profits which have been made in Germany, Italy and other fascist countries have not benefited the peasants, the handicraftsmen or the small shopkeepers but the heavy industrialists, who invest them either in their own or in similar undertakings, thus enlarging the domain of machinery and rational technique.

The charges made by Veit against his second and more dangerous adversary, dialectical materialism, testify to the fact that Marx has been more frequently criticized than understood. Veit is of the opinion that—according to Marx—the worker has been enslaved by the machine. Even a very superficial knowledge of the Marxian system gives ample proof that the above-mentioned representation of the Marxian philosophy is utterly misleading. Marx never speaks of 'the machine' without further specification, that is, without regard to the social system in which 'the machine' is being conducted, but he draws a clear and sharp distinction between the results brought about by the machine in capitalism on one hand, and in socialism on the other; this differentiation may be right or wrong, but it is impossible to criticize a thinker for ideas he never propounded.

Since Veit neither shares the romantic nor the socialist point of view (each of which is consistent in itself), his own literary contribution towards the solution of the cultural crisis remains exceedingly vague and unprecise. He does not cross the border which had already been reached by Nietzsche and others; logically he lags far behind his predecessors. Against the will of the author, his book has become a justification of that critical stage of development in the overcoming of which he wishes to co-operate.

ALFRED MEUSEL.

Palæocene Mammals

Paleocene Faunas of the San Juan Basin, New Mexico

By W. D. Matthew. (Transactions of the American Philosophical Society, New Series, Vol. 30.) Pp. viii + 510 + 65 plates. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1937.) 22s. 6d. net.

GREAT strides have been made in recent years in the field of mammalian palæontology, and the evolution of some at least of the orders of mammals are now set out with a great wealth of detail. Osborn's great monograph of the Titanotheres, for example, or his history of the Proboscidea, of which the first volume has recently appeared, show in a very striking manner not only how great is the amount of material on which to work, but also how complex has been the course

of evolution of the mammalian orders. These works, however, and others similar, do not, as a rule, begin their story before the Eocene, by which time the orders dealt with had become well established. Their 'pre-history' and inter-relationships, therefore, are not elucidated.

Simpson's classical monographs on the Mesozoic mammals have given us all the information that is as yet possible as to the dawn of mammals from their reptilian ancestors and of their evolution up to the, as yet little known, Cretaceous period; but thereafter until the Lower Eocene, by which time the mammalian orders had for the most part become defined, there has been a serious gap in our knowledge. At one time, this hiatus seems to have been considered as a comparatively small affair termed merely the 'Basal Eocene'. Now, as the Palæocene, it takes rank as one of the

major divisions of the Tertiary, equivalent in importance with the Eocene, Oligocene or other of the periods.

The late Dr. W. D. Matthew's monograph on the Palæocene faunas of the San Juan Basin of New Mexico, as a résumé of previous information and a great addition of new, is a most important contribution to the early history of mammalian evolution. The San Juan formations yield a series of deposits ranging from the Upper Cretaceous, separated by an unconformity from the Puerco, Torrejon and Tiffany beds of the Lower, Middle and Upper Palæocene respectively, to the Wasatch beds of the Lower Eocene. This covers a great range in time, and the faunal list of mammals (a smaller list of reptiles is also included) is impressive with its forty, or more, genera distributed among fourteen families and no less than seven orders. A few of these, such as the Multituberculates, are remnants of the earlier Mesozoic radiation that were dying out, but among the Creodonta, Condylarthra and Insectivora may be sought the foundation members of our modern mammals, and by implication some picture may be made out of the centralized common ancestors all of which must have flourished during the little-known Cretaceous period. A diagram is here reproduced (Fig. 1) which shows, in a summary form, the author's conclusions as to the relationship of the mammals of the period and, incidentally, where our knowledge is still lacking.

The bulk of the volume, after a short explanatory introduction, is devoted to a systematic and descriptive revision of the Palæocene mammals of New Mexico, and is followed by some general observations and conclusions. The descriptions of the various species, the eighty text figures and sixty-four quarto plates leave nothing to be desired.

No one familiar with Matthew's numerous other contributions would expect the general observations and the discussion which conclude the work to be other than stimulating. The origin and evolution of the tritubercular tooth, the characters of the feet and limbs from their primary types and of the skull and

skeleton generally, all receive illuminating treatment, as also does the account of the correlation of the different faunas and the origin and evolution of the tertiary mammals as a whole. The last word on this great assembly of early mammals has yet to be said. Many species are still known only from fragments, and the patient collecting which began under Cope so far back as 1880 must still go on in order to fill up the gaps in our knowledge. All future workers in this field will turn to the present volume

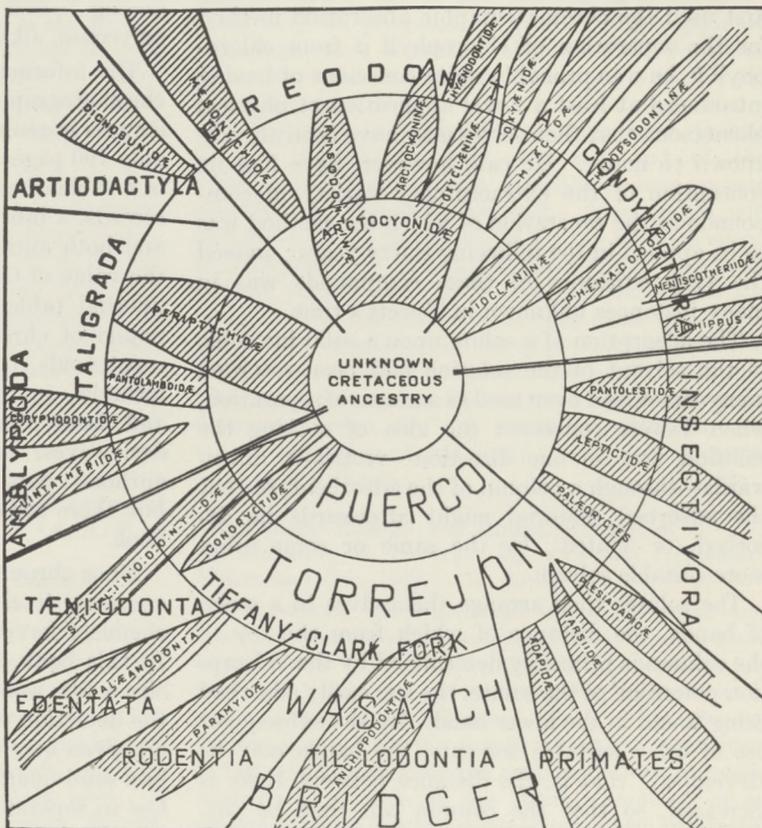


Fig. 1.

RELATIONSHIP OF THE MAMMALS OF THE CRETACEOUS. FROM MATTHEW'S "PALEOCENE FAUNAS OF THE SAN JUAN BASIN, NEW MEXICO".

as a classic for guidance and inspiration.

Although the editors (Prof. W. K. Gregory, Dr. Granger and Dr. Colbert with the assistance of Dr. Simpson) state that their work has been limited to an "addition of references", the thanks of all workers in mammalian palæontology are due to them for the labour of seeing the volume through the press so efficiently, and to the Trustees of the American Museum and to the American Philosophical Society of Philadelphia for their public spirit in making possible the publication of so useful and important a work.

C. F. C.

Adsorption Columns

Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen. Von Prof. Dr. L. Zechmeister und Dr. L. v. Cholnoky. Pp. xi + 231. (Wien: Julius Springer, 1937.) 14.40 gold marks.

WHEN Tswett, to whom the authors of this book refer as "genialer russischer Botaniker", first used the chromatographic adsorption method for the separation of chlorophyll *a* from chlorophyll *b*, he was probably quite conscious of having introduced at least a novel application of physical phenomena that themselves may have been already known to many. He can, however, have had no conception of the extraordinary variety of compounds to the separation of which the method was to be applied in the following thirty years; indeed the very existence of these compounds was in many instances unknown in Tswett's time.

The adsorption of a solute upon a solid insoluble in the solvent of the solution had been recorded many times, and even used as a means of separation, when Tswett conceived the idea of making the solution flow in one direction—vertically downwards—through a column of the adsorbent, so that the adsorbed material might afterwards be desorbed, or 'eluted', by the same or some other more suitable solvent.

The solutes then arrange themselves in a series of bands, the distance of which from the top of the column is primarily determined by the 'adsorption potential' of the solute, the less easily adsorbed being found in the lower band. By the subsequent use of other suitable solvents, the bands may be 'developed', that is, the distance between them is increased, so that the column can then be cut, and the bands separated mechanically from each other. Alternatively, the principle of the 'liquid chromatogram' may be employed; in this application, the undeveloped bands are washed out *seriatim* into different containers, by using an eluent with solvent properties suitably related to the adsorption potentials of the materials in the various bands.

It is of more than historical interest to note that one of Tswett's original columns consisted of sucrose, his solvent being a suitable organic liquid. We have come to-day to think of adsorbents so much in terms of acid clays, alumina, calcium carbonate or hydroxide, and so on, that we are apt to forget the relativity of adsorbent, solvent and adsorbate.

The first, or general part of this book is divided into two chapters, on fundamental principles and

methods respectively. The special, or second, part is divided into three chapters, covering in turn natural colouring matters (including chlorophyll, prophyryns, carotenoids, naphthaquinone and anthraquinone dyes, flavones, pterines, anthocyanins, etc.), synthetic or artificial colouring matters, and various colourless or slightly coloured substances—among which occur terpenes, glycosides and aglycones, alkaloids, vitamins, enzymes, and so on.

The information given about the application of chromatographic methods to such diverse substances is remarkably complete for a volume with only 190 pages of text (the rest of the book consists of a table of contents, some plates of photographic records, a bibliography with nearly 400 references, and both author and subject indexes). Moreover, the value of the book is further enhanced by some unusual tables, "thrown in", as it were, with a pound of chromatography. The complete list of carotenoids of known constitution, with their formulæ, in order of their adsorption-potentials, and, later, the list of all known carotenoids and derivatives, with their sources, show where the authors' personal special interests have lain, but there are no other signs of predilection in the book.

Since chromatography is essentially a method of *analysis*, it is rather surprising that analytical chemists have so far made very little use of it. In this book, the authors have only been able to cite a few isolated applications, as for example to the detection of falsification in the colour of wines, and even here the method is qualitative only, or at best semi-quantitative. When, however, the analyst has to separate two solid substances the chemical constitutions of which are sufficiently close to make separation by precipitation or crystallization either incomplete or impossible, precision chromatography would seem to offer a possible technique, provided the substances are reasonably stable in solutions of appropriate strength.

This admirable and comprehensive monograph by Prof. Zechmeister and Dr. v. Cholnoky, of the University of Pecs, both well-known exponents of chromatography, to the literature of which they have themselves made valuable contributions, is about as good as such a book can be. Clearly produced, logically arranged, painstaking in its presentation of detail, exhaustive in its citation of examples—it is the complete handbook for the practising or would-be chromatographer. An English edition is urgently needed.

A. L. BACHARACH.

Reports of the Progress of Applied Chemistry
Vol. 21, 1936. Pp. 875. (London: Society of Chemical Industry, 1937.)

THIS volume appears so punctually year by year soon after the end of the period surveyed, and is so consistently full of well-digested reports, that every English-reading chemist must now be fully aware of its value; indeed, with many its appearance is reckoned an event. One reason for the welcome which always attends its arrival is evident; for after twelve months' struggle to keep one's head above the flood of chemical literature in which one is even mildly interested, a raft on which one may float awhile and contemplate the scenery is not to be despised. These surveys of progress in the several branches of technological chemistry appeal also to those who, having sufficient chemistry to follow their purport, are however not engaged in the work they describe, and perhaps would not regard themselves as chemists at all.

Among the new contributors are Mr. M. B. Donald (general, plant, and machinery), Dr. J. Grant (pulp and paper), and Dr. J. A. Sugden (refractories, ceramics, and cements), while Prof. W. E. S. Turner (glass) and Dr. D. F. Twiss (rubber) are old friends who have returned. This year the biennial report on explosives is included. There are 26 sections in all, with general name and subject indexes, and of course the information presented is lavishly documented, references being given both to original sources and to abstracts. It would probably be fair to describe the Report as a whole as "better than ever"; which means that it reflects steady progress both in technical achievement and in presentation. A. A. E.

Polychromatic Plates for Color Sense Examination
By Dr. E. B. Rabkin. Pp. 40+xx plates. (Kharkov: State Medical Publishing Board, 1936.) 30 roubles.

THIS series of tests for colour defect issues from the laboratory for colour vision of the Hirshman Memorial Ukrainian Central Ophthalmic Institute, of which Dr. Rabkin is the director. The tests are composed of coloured figures on coloured backgrounds, such as are found in the Stilling and the Ishihara tests. A number of the plates contain also 'hidden' figures, which are visible only to the dichromate. Triangles, circles and squares appear on some plates instead of figures, and so can be used for testing children and illiterates. A diagnosis can be made from the tables of dichromasy in general, and of protanopia, deuteranopia, and tritanopia in particular. The author claims, too, from the tests that "the simpler forms of anomalous trichromasy" can also be detected. Plates are added to detect simulation.

The series itself has been tested out in the Experimental Ophthalmic Clinic of the Institute of Experimental Medicine at Kharkov, and has proved successful. It seems, if one can judge from a preliminary survey, to give satisfactory results, and can be recommended. The book contains detailed and clear instructions in both Russian and English, although the English translation contains some curious phrases and sentences, and the spelling is not always of the best. MARY COLLINS.

Organic Syntheses:

an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. L. F. Fieser, Editor-in-Chief. Vol. 17. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 8s. 6d. net.

PRODUCED on the plan now familiar to organic chemists and biochemists, the latest addition to this series contains details of thirty preparations. Among the open-chain substances are γ -aminobutyric acid, made by a modification of Gabriel's method; ϵ -aminocaproic acid, prepared from 2-ketohexamethylenimine; and 1,3-butadiene. It is stated that between 25 gm. and 30 gm. per hour of crude butadiene may be produced by passing the vapour of cyclohexene over a cracking element, in an ingenious apparatus which is here fully described with the aid of a diagram.

Of interest in carbohydrate chemistry is the account of the acetolysis of cotton, and of the hydrolysis of the resulting α -cellobiose octa-acetate according to Zemplén's method. Biochemists will also welcome the details given for the hydrogenation of cholesterol to dihydrocholesterol (β -cholestanol) and the oxidation of this to cholestanone. Under the heading of 2-carbethoxycyclopentanone (prepared from ethyl adipate) may be found a description of the useful Hershberg stirrer for pasty mixtures. Finally, the stereochemist is catered for in the precise directions given for the synthesis and complete optical resolution of that useful stereochemical agent, α -phenylethylamine. J. R.

Mechanistic Biology and Animal Behaviour

By Theodore H. Savory. Pp. xv+182. (London: Watts and Co., 1936.) 7s. 6d. net.

MR. SAVORY'S book gives an eminently lucid and readable description of tropistic behaviour in some invertebrate organisms. The book, however, is largely devoted to an unconvincing exposition of certain well-worn theoretical issues. Mr. Savory defines his aim as the purely objective description of behaviour, which for the purposes of deterministic analysis he regards as the "visible response of an animal to some kind of stimulation which originates most frequently from a disturbance of its environment". He strays, however, from the logical demands of his definition, which is generally accepted by scientific students of behaviour, when he leaves the field of straightforward description. Thus, when he departs from the world of invertebrate organisms with which he is familiar, and discusses mammalian forms such as dogs, he accepts *a priori* concepts such as 'mind' and 'intelligent' as opposed to 'sub-intelligent' behaviour, and fails to realize that to the student of behaviour these concepts are somewhat empty. It is clearly illogical for the experimental investigator to ask whether spiders that lurk under stones have mind and self-awareness, and then to answer 'no' merely because the particular tropisms which drive spiders under stones have been defined.

The book closes with an uncritical statement about the influence of acquired habits on the course of arachnid evolution.

Measurement of Submarine Daylight

By Dr. H. H. Poole

SUBMARINE measurements of solar radiation are of interest to oceanographers, who are concerned with such problems as the rate of rise of temperature of the water, the rate of photosynthesis, the movements of zooplankton, or the depth limits of daylight vision for fish. They also enable us to measure the opacity of the water, which, being an index of the amount of matter in suspension, may give valuable evidence as to its previous history, and is likely to be of importance in connexion with the nutrition and migration of fish.

A thermopile with suitable colour filters has been used by Birge and Juday to measure the total radiation, and that in different spectral bands, at various depths in American lakes, but for work at sea the measurement of the very small potential differences presents difficulties. As the spectral sensitivity range of the selenium rectifier photoelectric cell covers the band showing appreciable penetration through sea-water, it appears to be the most convenient instrument at present available for submarine work.

This cell has a range of sensitivity extending somewhat beyond both ends of the visible spectrum, with a maximum about $595\text{ m}\mu$ (that of the eye being about $555\text{ m}\mu$). It appears to be permanent, apart from temporary fatigue or temperature effects, which may amount to a few per cent in strong illumination. For small illuminations the current generated is proportional to the light, but in strong light the ratio current/illumination falls appreciably, and the necessary corrections must be found if the cell is to be used to measure intense illumination. The fall in this ratio with increasing illumination becomes much more important with a high-resistance external circuit, so that a low-resistance measuring instrument is always desirable, and sometimes essential.

The Weston selenium cell which has been used by Utterback, and also by Atkins and Poole, gives, when exposed under a sheet of opal-flashed diffusing glass, a current of one microampere for about 20 lux. With a 10 ohm galvanometer the sensitivity would fall to about $1\text{ }\mu\text{amp. per } 25\text{ lux}$ in full sunlight. The Lange selenium cell used by Pettersson is more sensitive, giving $1\text{ }\mu\text{amp.}$ for about 5 lux in weak light. The fall in sensitivity in strong light is, however, so great that the

cell must be protected by a suitable reducing screen when used to measure bright daylight. This screen must be removed for weak light readings.

The choice of a suitable instrument to measure the current presents certain difficulties, as the claims of current sensitivity, lowness of resistance, quickness of reading, and insensitivity to the motion of the ship, are not easily reconciled. Utterback has used a special marine galvanometer, Atkins and Poole a modified form of their potentiometer method previously used with emission cells, adapted so as to include the principle and advantages of the zero-resistance circuit devised by Campbell and Freeth, while Pettersson, aided by the greater sensitiveness of his Lange cells and the comparative steadiness of his ship, has found simpler pointer and light-spot galvanometers satisfactory in his work.

The cell mounted behind a strong glass window in a watertight case is lowered to any required depth by means of a wire and a spar projecting over the ship's stern, thus minimizing the shading effect of the ship and the vertical movements due to rolling. Utterback uses a case large enough to contain a set of colour filters, which can be interchanged by an electromagnetic device. This is a great advantage, but the size and complication of the apparatus are drawbacks, and most workers have contented themselves with the use of external filters laid on the window, which is generally horizontal, and changed by hauling the photometer on board. Above the colour filter is placed the opal diffusing glass, the use of which is rendered necessary by the varying obliquity of the illumination to be measured. The transmission of the colour filter is not affected by such variations in obliquity, as the filter is below the opal, and submarine light the obliquity of which is greater than 48° , and which would be prevented by internal reflection from reaching the cell if the diffusing glass were absent, can reach the internal diffusing layer in the opal glass and be duly measured.

The use of colour filters to limit the range of sensitivity is rendered necessary by the differential absorption of the water, which entirely alters the average composition of the radiation with depth, and thus alters also the sensitivity of the cell, so

that it is very difficult to interpret the submarine readings of a selenium cell without filter. The following Jena glass filters, each 2 mm. thick, seem to be suitable for general work: red, 720–600 m μ , *RG* 1; green, 600–480 m μ , *VG* 9; blue, 480–360 m μ , *BG* 12. The limits are only approximate and are affected by the falling sensitivity of the cell towards both ends of the spectrum.

The variations in the surface light must be observed by a second cell exposed under a similar filter and opal glass in a position on deck as free as possible from shading by spars and rigging. The photometer is directly compared side by side with the submarine photometer, and the simplest means of expressing the submarine illumination is as a percentage of the surface light in the same spectral band at the same instant.

It is more difficult to express the submarine illumination in definite units. The selenium cell, being more sensitive than the eye to both ends of the visible spectrum, does not differ very greatly from the latter in its estimate of common illuminations of different predominant colours. Thus, if it is standardized with a filament lamp at a colour temperature 2,360° K., it appears to under-rate average sunlight by some 10–20 per cent. The use of a higher temperature source for standardization reduces this discrepancy, and some workers have used for this purpose the Davis-Gibson colour filter, reproducing with fair accuracy average noon sunlight. We can then express in 'lux' the reading of a cell exposed without colour filter in air, without introducing any serious error, by the use of a term which is strictly only applicable to visual measurements. With colour filters, however, or under water, which acts as a colour filter, this quasi-visual scale becomes meaningless and misleading.

The ideal procedure is evidently to express the results in terms of the radiant power in the different spectral bands, say, in microwatts per square centimetre. Clarke has used this method of presentation for his work with emission cells in the western Atlantic, and Atkins and Poole have also standardized some of their cells in power units. The lowness of the colour temperature of all ordinary sources, however, limits the accuracy of the standardization, and has led Ångström to suggest a method of standardization by means of sunlight which may prove to be the best available.

There is general agreement between the results obtained by workers on both sides of the Atlantic and in the north-eastern Pacific, the large variations in the opacity of the water found by all being obviously due to local conditions. The clearest water so far recorded was found by Clarke in the Sargasso Sea. Working down to 180 metres,

he found a value as low as 0.03 for the extinction coefficient of blue light. This means that the fall in the illumination on a horizontal surface was only 3 per cent per metre, the light falling to one tenth of its value at about 80 m. depth. In this water both green and violet light gave coefficients close to 0.05, while for the light passing through an *RG* 1 filter Clarke found a coefficient 0.08 for depth range 20–80 m. This is an extraordinarily low coefficient for 'red' light, and may possibly be due to the action of the overlying water layers (in which the absorption was much more rapid) in removing all wave-lengths much longer than 600 m μ , leaving only a very narrow spectral band of orange-red.

In coastal waters higher coefficients are always found, the absorption of the shorter waves increasing more rapidly than that of the longer. Thus, in both the English Channel and in the north Pacific the coefficient for blue and green is generally about the same, and not far from 0.1 at a distance of 20 miles off shore, the illumination falling to one tenth of its value every 23 m., the corresponding average figures for red being 0.4 and 5.75 m. Closer inshore, green becomes the most penetrating colour, the coefficients for all colours rising with the increased turbidity of the water.

In considering the variation of opacity with depth, one must remember the 'hardening' effect of absorption on polychromatic radiation, although this effect is greatly reduced by the use of colour filters. It is still probably of importance with the *RG* 1 red filter, as the longer wave-lengths of the range covered are absorbed even more rapidly than those near the 600 m μ limit. The effect is probably of much less importance with the green and blue filters.

Real variations of opacity with depth are often met with. As a general rule, ocean water becomes clearer below the surface layers, but inshore waters often show irregular variations, which may be very useful for studying their stratification. For exploring these rapid changes of opacity the use of Petterson's transparency meter, which measures the intensity of a beam of artificial light reflected through 2 metres of water, is almost certainly preferable to the deduction of the opacity from the ratio of the daylight illuminations at two different depths, but it is not easy to correlate the results obtained by the two methods.

It is evidently highly desirable that oceanographers should be provided with a standardized method suitable for routine measurements of submarine daylight, and with this end in view the International Council for the Exploration of the Sea arranged for a special meeting of workers in the subject at the 1936 meeting at Copenhagen. It would seem that some further experience of the

available cells and modes of measurement is desirable before any definite specification of apparatus and methods can be drawn up. In the meantime, a fairly full review by different authors of the work done up to date, with extensive

bibliographies, will be found in the report of the 1936 meeting of the Council, and a report of the special sub-committee then appointed to consider the question is being presented at the meeting this month in Copenhagen.

Greenland Culture: (I) The Norsemen*

ACCOUNTS of the ill-fated Norse settlements in Greenland in medieval times, such as that recently published by Dr. Nörlund (see NATURE, 133, 949) have been based hitherto on the evidence afforded by the eastern settlement (now the district of Julianehaab), in which, thanks to the researches of the last fifty years, most problems of topography have been solved and the cultural history elucidated in no little detail by archaeological discovery. Of the western settlement, however, in the Godthaab District little was known either from literary sources or from archaeological investigation before the expeditions of the Commission for Scientific Research in Greenland, of which the results have been described recently by Dr. Aage Roussell. It was inferred, however, with reasonable certainty that the place now known as Kilaussarfik, visited by Daniel Brunn in 1904 and the site of Dr. Roussell's excavations in 1930, 1932 and 1934, was to be identified with Sandnes, and Ameralik Fjord with the ancient Lysufjördr, not least, perhaps, on account of the rarity of such a sandy formation on the rock-bound coast of Greenland. As, however, the area is being submerged rapidly, and the coast-line has changed considerably since the Middle Ages, this is by no means indisputable evidence.

Historical records relating to the west settlement are few. Apparently it was established simultaneously with, or just after, the east settlement, shortly before A.D. 1000. The Saga of Eirik the Red mentions a serious epidemic there in the first decade of the eleventh century. By the middle of the fourteenth century, Skraellings (Eskimo) had occupied all the west settlement, "so there are many horses, goats, cattle and sheep run wild, and no people, neither Christian nor heathen". All archaeological finds, in default of

evidence to the contrary, are to be regarded as prior to 1365.

In addition to the church at Sandnes and the neighbouring farm, of which the name is unknown, Dr. Roussell excavated in 1934 two other farm sites on the opposite side of the fjord. Of these, Umiviarsuk alone has been described, the important results obtained at Ujaragsuit still awaiting publication.

The site investigated at Sandnes included church and churchyard, house, smithy, and two large stable complexes. The store-house—invariably part of a Norse farm—presumably stood on the fjord bank, but, if so, it had been washed away. The central part of the farm had been built on sloping ground and a constant movement of soil has covered the whole site with midden, making it impossible to arrive at any accurate idea of stratification. At times, objects were found above others which obviously were of later date.

Since the date of Daniel Brunn's visit, the church ruins at Sandnes have suffered much damage owing to submergence and climatic conditions. Consequently it was found impossible to determine the extent of the churchyard; but accumulations of stones on the fjord beach indicate the probable limit of interment. Only in the westerly part of the churchyard were interments uncovered.

No less than forty-two burials were found huddled in a confined space. They lay under the midden in coarse yellow gravel and only just below the original surface. Owing to crowding, older graves frequently had been disturbed in digging new, and half skeletons, or skeletons with lower limbs hewn off, were found. As is usual in Christian burials, the body lay on the back with the head towards the west and arms crossed on the breast. One interment in the south end of the area contained two adults, presumably man and wife, with the skeleton of a child lying on each. Alongside and evidently buried at the same time lay a fifth skeleton, not fully grown, and beside the skeletons was a small crudely fashioned wooden cross, the only piece of grave furniture found *in situ*. It may be presumed that these five burials were the result of an epidemic, such as is mentioned in the sagas of Eirik and Thorfinn.

* Researches into Norse Culture in Greenland—Sandnes and the Neighbouring Farms. By Aage Roussell. Appendix: Greenland Runic Inscriptions, 4. (Meddelelser om Grønland, Bind 88, Nr. 2.) Pp. 232+6 plates. 11.00 kr.

Researches into Norse Culture in Greenland—Animal Remains from the West Settlement in Greenland, with Special Reference to Livestock. By Magnus Degerbøl. (Meddelelser om Grønland, Bind 88, Nr. 3.) Pp. 55+1 plate. 2.50 kr.

Researches into Norse Culture in Greenland—Evidence of Iron Extraction at Sandnes, in Greenland's West Settlement. By Niels Nielsen. (Meddelelser om Grønland, Bind 88, Nr. 4.) Pp. 14+1 plate. 0.75 kr.

(København: C. A. Reitzels Forlag, 1936.)

What was from the artistic point of view the most important find made in the course of this investigation may be mentioned here, as it came from the churchyard, though not found *in situ*. This was a carved slab of wood of unknown use, though it may have been part of the cover of a pyx. The wood has been identified as fir and driftwood. On it is carved in relief a representation of the Crucifixion showing the figures of the Virgin Mary and St. John in a pose and with attributes characteristic of medieval Scandinavian art. The figures are Gothic; but the ornament is still Romanesque. Though unquestionably of Scandinavian origin, it is not of local workmanship, and may derive from thirteenth century Iceland, or possibly Norway. Examples of local workmanship are to be seen in representations of the Crucifixion, rough in character, in which the figures in metal had been nailed on in a technique familiar in examples known from Iceland.

The important site at Umiviarsuk afforded fuller detail than Sandnes of the cultural level of the Norse farm, though here in the excavation of the house itself the work of clearing the plan was complicated by the fact that a later building overlay one and possibly two earlier structures. The farm buildings of the west settlement were substantial erections of stone. It was possible to ascertain the disposition of living rooms, sleeping rooms, hearths, etc. Immediately behind the farm-buildings at Sandnes was a series, or rather two complexes, of outbuildings for cattle, sheep, pigs, and goats and the farm workshop. In one of these, stone divisions provided 'boxes' for tethering the cattle; while in another, small finds suggested that one or more of the humbler female servants had slept here. Sandnes also had a small forge, which afforded samples of the iron used in working.

An interesting building at Umiviarsuk was a bath house, which, though the bath is frequently mentioned in the records, is the first to be found in Greenland. It is of the usual vapour-bath type, with furnace and shelves, on which the bathers reclined. It was apart from the house, and if the bathers did not follow the modern practice in high latitudes of a cold plunge in the snow, they at least had to pass through the cold air in returning to the house. Another find on this site of an unusual character was a movable bed. Although there are references to such beds in the sagas, its use had died out in the Middle Ages in favour of the bed fixed to the wall. It was not reintroduced until the sixteenth century; but its survival in Greenland points to the backward state of the community.

The most noteworthy feature in the work of Dr. Roussell's expeditions is the very large number

of small objects found, which has thrown a flood of fresh light on Norse culture in Greenland. The character of the soil enabled the preservation of a number of objects, especially in wood, bone and baleen, which had perished on sites previously excavated. Nearly twelve hundred objects in all were found. The state of preservation may be judged from the fact that in some the original colour of the wood can still be discerned. Among the small objects, one of the most interesting is a toy model of a boat, which reproduces its original in accurate detail. Comparison with earlier known examples of the Norse boat dating from the sixth century shows that the form of ship virtually suffered no change over a period of six hundred years.

Other finds included tools, weapons, implements, household utensils, clothes, games such as chess, dice and draughts, toys and objects of unknown use. Trinkets were rare. In addition to the objects of art already mentioned—the wood-carvings of a religious character—there was a number of small objects in bone, wood and ivory, including two lively representations of animals, a bear and a walrus, and two of the human face, of which one in walrus ivory with its wide mouth, long upper lip, heavy jaw and coarse skin gives anything but a favourable impression of the physical type of some, at least, of the Greenlanders.

The animal bones indicate that the inhabitants of the western settlement kept cows, sheep, horses, pigs and dogs and hunted the same wild animals, reindeer, seals, whales, arctic foxes, arctic hares, and polar bears, as the settlers on the east coast. For the first time, the bones of the dog are available for comparison with representations of the animal of this period. The surprising feature is the length and slenderness of the legs, which suggest a breed of something of the greyhound type.

Although there is evidence to suggest that the Norsemen had extracted iron in Greenland, the number of iron objects found is small. The material from Sandnes is the most considerable find that has been made, consisting of fifty lumps of slag and a small piece of hammered iron of prismatic form. The material has been subjected to detailed examination and is very heterogeneous. Two types of iron are present, which agrees with what is known of Middle Age practice of producing iron in hearth pits, and shows the difficulty experienced by the ancients in producing iron capable of hardening. While some samples consist of a soft iron, practically devoid of carbon, others are a medium hard carbon steel. The evidence from Sandnes is taken to show that the Norsemen did produce a form of steel, but that their methods of working and exposure to the air reduced the product finally to nothing but a soft iron.

Belgian Stratosphere Balloon Experiment

THE most difficult part of the planning of a large stratospheric balloon is how to control the rate of descent in the upper atmosphere. If a balloon is large enough to reach about 19 miles (1/100 atmosphere) the hydrogen must contract during the descent, and the bag will be only 10 per cent filled at 10 miles: it is then difficult to avoid a dangerous flapping of the bag, except by controlling the speed by a continuous dropping of ballast; incidentally, the weight of that extra ballast would have reduced the maximum altitude reached.

If air is allowed to flow into the bag through

long as before, and about twenty times as heavy, which weight is prohibitive. To calculate the minimum diameter admissible, it is necessary to know exactly the amount of heating inside the bag due to the sun. As it depends on the thermal air eddies inside and outside the bag, it is useless to try to determine that quantity by extrapolation from experiments made on models a few feet in diameter. In order to measure the heat transfer on a model as large as possible, an experimental ascent was planned by A. Piccard and M. Cosyns with the old *F.N.R.S.* filled with hot air. At an altitude of about 5 miles, the heating power of the sun is not very far from its maximum value, and the temperature is about the same as at 20 miles. Knowing the total weight of the balloon, and the amount of supplementary heat necessary to balance it, the temperature rise due to the sun could be deduced with a precision of a few tenths of a degree.

The supplementary calories were to be furnished by a burner placed inside the bag (Fig. 1*b*) using pure propane, 150 lb. of which was carried in the liquid state in an aluminium bottle weighing 60 lb. The burner was able to burn 2 lb. of propane each minute, with good efficiency, and twice as much in emergency (the

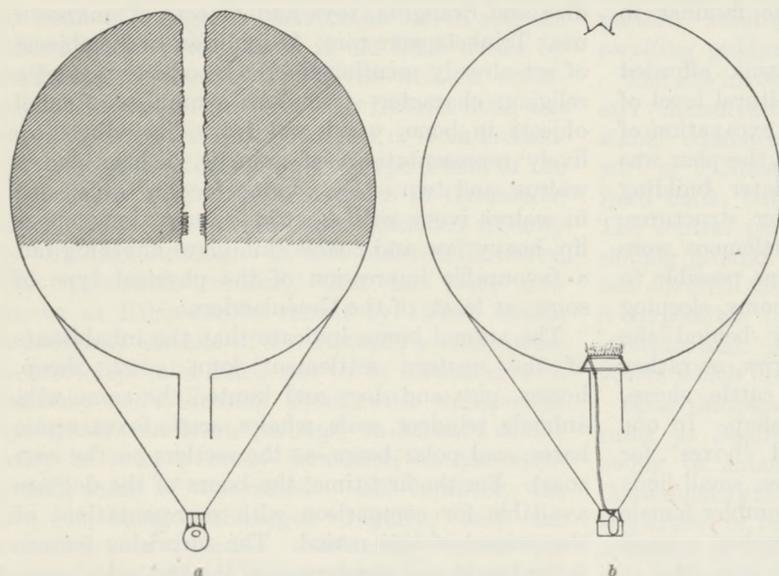


Fig. 1.

the appendix, the flapping danger disappears; but, during the daytime, the sun heating the air in the bag causes sufficient expansion to stop the descent, even if all the hydrogen is removed. A better solution seems to be to admit air, but to remove it automatically as soon as it is warmed. That method was tested by Max Cosyns during his 1934 ascent, by replacing the valve of his balloon by a collapsible fabric tube, about six feet in diameter, distended by wooden rings, and stretching down the axis of the balloon (Fig. 1*a*). If the opening of that tube is set near the limit between the hydrogen and the air, the air flows continuously upwards as soon as it is warmed. The method worked perfectly well on the *F.N.R.S.*, the diameter of which was 100 ft.

For a 200-ft. balloon, the use of the same principle would require a tube 17 ft. in diameter, twice as

lifting power given by a pound of propane is about 160 lb.). It was composed by 42 batwing-burners placed on a ring 7 ft. in diameter, to ensure a good mixture of hot and cold air, and to prevent a flow of gases at too high a temperature from reaching the top of the balloon. The flow of propane was measured by a diaphragm 'dèprimomètre,' and by weighing at intervals the aluminium bottle.

Unfortunately, just before starting on May 25, the twisting of some ropes obliged the land crew to release some of the slings, and an unforeseen squall shook violently the bottom of the balloon, upturning the burner before it was possible to shut off the flame; the bag of the balloon was destroyed by fire in about a minute. The material loss was not important, as the *F.N.R.S.* was getting old and was about to be dismantled.

M. COSYNS.

News and Views

Prof. F. W. Thomas, C.I.E.

PROF. F. W. THOMAS of Oxford has been elected president of the ninth All-India Oriental Conference, which will be held at Trivandrum in December next. He has also been elected a corresponding fellow of the Philosophical and Historical Section of the Prussian Academy of Sciences. Prof. Thomas, who has been Boden professor of Sanskrit in the University of Oxford since 1927, and is a fellow of Balliol College, was librarian of the India Office from 1903 until 1927, and was awarded the C.I.E. in the honours list of 1928 on his retirement from that office. He is chairman of the Section of Oriental Studies of the British Academy, and represents that body as a governor of the School of Oriental Studies of the University of London. He is also reader in Tibetan and lecturer in comparative philology in the University of London. Prof. Thomas has long been known as one of the foremost scholars in the classical languages of the East, in which he has acted as examiner not only in all the universities in Great Britain which offer a course in those languages, but also in the principal universities of India. His outstanding knowledge of Buddhist art and literature received the signal recognition of the award of a medal in 1934 at the Tokyo celebration of the two thousandth anniversary of the birth of Buddha. He is the author of a large number of publications on the philology and literature of Sanskrit, Pali and other oriental languages, as well as on the art and literature of Buddhism.

Prof. Walter G. Cady

THE Council of the Physical Society has awarded the fourteenth Duddell Medal to Walter G. Cady, professor of physics at the Wesleyan University, Middletown, Connecticut, U.S.A., for his work on piezo-electric resonators and oscillators as standards of frequency. Prof. Cady's pioneer work on the subject was published in 1922 (*Proc. Inst. Radio Eng.*, 10, 83) and the value of the device may be judged from the fact that it stimulated research work on the subject in all parts of the world, more than a thousand papers having been published on the properties of piezo-electric crystals since the appearance of Cady's first paper. Of course, these are not all due to Cady's work, for Langevin had previously used piezo-electric crystals as vibrators for underwater signalling, but Cady's particular contribution—the use of the quartz resonator as a standard of time or frequency—has quite obviously inspired most of the work. The use of these resonators as standard vibrators has made it possible to measure frequency and intervals of time with an accuracy not previously attained. It is scarcely necessary to emphasize the importance to physics of increased accuracy in such fundamental measurements. Among the applications which have already been made the following may be

mentioned: (1) The quartz-clock now used as standard in some observatories. It is in some respects superior to the pendulum clocks, and in any event is a most valuable supplement to them. (2) The measurement and control of the frequency of alternating currents in connexion with measurements of dielectric constant, 'absolute' electrical measurements, etc. (3) The measurement of the velocity of ultrasonic sound waves. Duddell, who was responsible for so much elegant instrumental work, would have been the first to recognize the beauty of Prof. Cady's device, and it will be a source of great satisfaction to all scientific workers to know that the value of Prof. Cady's work has been recognized in such an appropriate manner.

Centenary of the University of Durham

THE University of Durham, though now well over a hundred years old, has just celebrated its centenary. It was originally intended to hold the celebrations five years ago, since the Act of Parliament which provided for the foundation was passed in 1832. Owing to the economic depression, however, it was felt inappropriate to enter into rejoicings under the cloud of industrial stagnation which, in 1932, was locally responsible for widespread distress. The present year has a historical claim to recognition, apart from the atmosphere of returning prosperity, for it was in 1837 that the University was granted its charter by William IV. Moreover, as a result of the recent Royal Commission, the University is about to enter upon a new phase of its history. The main celebrations were held at Durham on July 1, and were attended by delegates from all the other Universities of the British Isles and from several in Canada, Australia, New Zealand, South Africa, India and the United States. Learned societies were represented by, among others, Sir William Bragg, Lord Dawson of Penn, Dr. H. Spencer Jones, Prof. F. G. Donnan and Prof. O. T. Jones. After a morning visit to the Colleges, including the Castle, a centenary service was held in the Cathedral, where the preacher was the Bishop of Durham. The keynote of Dr. Henson's discourse was that universities are the "watchdogs of human liberty". "The new universities," he said, "were born and cradled in an atmosphere of freedom. They surely must stand in the forefront of the champions of academic liberty against the aggressions of the totalitarian State or the subtler assaults of racial fanaticism". After the service, the delegates were entertained to luncheon, some in the Great Hall of the Castle (by the University), and others at the Town Hall (by Lord Londonderry, Chancellor of the University and Mayor of Durham).

IN the afternoon, a Centenary Convocation was staged in the picturesque surroundings of the Castle quadrangle. Each delegate was introduced to the

Chancellor, to whom addresses of congratulation were presented. The Chancellor then conferred the honorary degree of D.C.L. upon nine distinguished men: Dr. C. A. Allington, Dean of Durham; Prof. P. P. Bedson, emeritus professor of chemistry; Lord Cadman, an old graduate of the University; the Hon. J. A. Hanan, chancellor of the University of New Zealand; Sir John Jarvis, the promoter of many schemes to help the distressed area of Jarrow; the Rev. S. R. P. Mouldsdales, until recently principal of St. Chad's College; Mr. Tracy Philipps, explorer and war correspondent; Sir Cuthbert Wallace, president of the Royal College of Surgeons; and Mr. G. H. A. Wilson, master of Clare College and vice-chancellor of the University of Cambridge. Convocation was followed by a garden party in the adjoining Fellows' Garden. Later, the delegates were entertained to a banquet in the Great Hall, after which they were received by the Council of the Durham Colleges.

It is interesting to record that so early as 1650 a petition to Parliament that a college be established at Durham was approved by Cromwell. When university powers were applied for, however, the proposal was thought to be prejudicial to the older universities and the Great Seal was withheld. No more was heard of a northern university until a draft scheme was drawn up in 1831. The necessary Act was passed in 1832, and the first students came into residence during the following year. Among the first members of staff was J. F. W. Johnstone, lecturer in chemistry and mineralogy. About the same time (1834) the Newcastle-upon-Tyne College of Medicine originated, though it did not become connected with the University of Durham until 1852. Durham College of Physical Science was founded in Newcastle in 1871. It had then four professors—mathematics, physics, chemistry and geology—but by the time its name was changed to Armstrong College, in 1904, a very wide range of university subjects had long been incorporated. Now, both the College of Medicine and Armstrong College are about to be united, under the revised constitution of the University, as a new corporate body to be known henceforth as King's College. At Durham itself, science seems to have lapsed after the death of Johnstone in 1855. Since 1924, however, when the first block of the present Science Laboratories was opened, several very flourishing schools have developed. Under the new regime, the University of Durham (consisting of the Durham Colleges, together with King's College, Newcastle-upon-Tyne) enters the most promising period of its history, with every prospect of expanding achievement and prosperity.

The World's Air Altitude Record

THE world's air altitude record was regained for Great Britain by the Royal Air Force on June 30, by a flight to an altitude of 53,937 feet (more than ten miles). The previous record of 51,362 feet was held by Lieut.-Colonel Mario Pezzi for Italy, who beat the then British record of 49,944 feet last autumn. The flight was made from the aerodrome

of the Royal Aircraft Establishment, Farnborough, by Flight-Lieut. M. J. Adam, using the Bristol 138 experimental high altitude aircraft. This was the same machine as used by Flight-Lieut. Swain, R.A.F., for the previous record, but was fitted with a special Bristol Pegasus engine. It had various detail improvements as suggested by experience. The pilot wore the actual high-pressure suit that was prepared as a reserve for the previous record flight, with small improvements. These included precautions against 'frosting up' of the Celestroid windows of the headpiece, and an emergency breathing pipe to lead air direct from the outside when necessary, instead of having to slash open the front of the headpiece as did Flight-Lieut. Swain, upon landing, after his flight. The transparent material forming the cabin roof was observed to crack upon reaching an altitude of about 48,000 feet, but this was not serious enough to interfere with the continuation of the flight.

THE ascent was made in 1 hr. 35 min., and the total time of the flight was 2 hr. 15 min. The minimum pressure and temperature were 77.8 mm. of mercury and -48.9° C. respectively, both occurring at the maximum height. The pilot experienced a good deal of navigational trouble due to cloud-layers at intervals, at one time being forced to fly east, facing the sun, which at 6 a.m. was low enough to blind him. A steady north-westerly wind, estimated by the pilot to be of about 100 miles an hour velocity, was encountered in the upper regions. It is understood that the aircraft will continue to be employed upon researches into conditions of flight in the upper atmosphere.

Atlantic Air Mail Service

THE first test flight of the Atlantic air mail service began on July 5 when the Imperial Airways flying-boat *Caledonia* left Foynes, Ireland, for Botwood, Newfoundland, and two and a half hours later the Pan-American Airways *Clipper III* took off from Botwood on the easterly crossing. The two boats alighted at their destinations within a quarter of an hour of each other on July 6. The *Caledonia*, under Captain A. S. Wilcockson, flew mostly at a height of 1,500 ft. to avoid the worst of the head-wind; she followed a rhumb line course at an average speed of about 132 miles an hour and was in the air for 15 hr. 28 min. The *Clipper III*, under Captain H. Gray, flew most of the way at 10,000 ft. to make the most of the following westerly wind; she kept roughly to a great circle course and her average speed was 156 miles per hour and flying time 12 hr. 37 min. Both commanders described the crossing as comparatively uneventful, and paid high tribute to the work of the wireless stations on both sides of the Atlantic in assisting their navigation.

Centenary of the General Register Office

AN exhibition which opened on July 1 at the General Register Office, Somerset House, Strand, London, W.C.2, for a duration to be announced later,

marks the centenary of the establishment of the general registration of births, deaths, and marriages in England and Wales, by illustrating the work of the Office, as well as the character of the records which are in its charge. Although the system of civil registration was established only one hundred years ago, its origins in England go back no less than four hundred years. Such statistical material relating to the population, outside the parochial records, as was recorded before 1837 was transferred to the custody of the Registrar General under the Marriage and Registration Acts of 1836. The earliest form of record, the parochial register of baptisms, marriages and burials, was established by Thomas Cromwell in 1538; but so long ago as the sixteenth century the value of demographic data and the inadequacy of the parochial system for this purpose were appreciated.

IN 1590, Lord Burleigh put forward a proposal for the establishment of an office for a general register to summarize "how many christenings, weddings and burials were every year in England and Wales". The proposal was not adopted; and subsequent attempts to secure some measure of systematic collection of facts were both unsatisfactory in working and incomplete, owing to increase in the number of nonconformists, who did not avail themselves of the services of the parish church. It was owing to this latter factor that the earliest records now preserved at Somerset House are those which did not come within the established order, belonging to the refugee churches of Walloons and French, the Chapels Royal, the Independents, and the Society of Friends of the sixteenth and seventeenth centuries. It is interesting to note that the last-named body, with characteristic precision, was the first to register births and deaths, rather than baptisms and burials. The official guide to the exhibition ("The Story of the General Register Office and its Origins from 1538 to 1937". Pp. 30+6 plates. London: H.M.S.O. 6d.) deals with these and other matters of much sociological interest, especially in the light thrown by the registers on the early history of nonconformity and the scandalous 'Fleet' marriages.

Ethnological Museums: Methods and Limitations

DR. H. S. HARRISON, in his presidential address to the Royal Anthropological Institute delivered on June 29, played the part of a wandering sceptic, to use his own term, to excellent effect in setting out some of the more striking shortcomings of the ethnological museum as a place of exhibition of material objects bearing on man's cultural development. As he pointed out, there is a considerable body of exhibits, such as, for example, musical instruments, personal ornaments, money and currency, which find their place in a museum as 'material objects', but of which the real significance is non-material and is lost on either the distributional or comparative method of arrangement, as their interest lies not in form or material, but in their sociological functions and meanings. Practical considerations limit the use of labels, quite apart from the danger of the museum

becoming what Dr. Harrison said has been described as a collection of labels illustrated by exhibits. Dr. Harrison also showed himself a keen but kindly critic of the evolutionary method of display, pointing out its weaknesses in the scanty evidence and uncertainties relating to origins, the necessary, but at times excessive dependence upon inference, and the ambiguities of direction, including the possibility of degeneracy. Among the instances quoted in support of the argument he cited an interesting example in the uncertain development of the canoe and the relation of the plank and dug-out forms.

WITH a sympathy born of experience, Dr. Harrison recognizes the limitations imposed by space on experiment to meet defects inherent in present museum methods, but hopes for their alleviation in a National Anthropological Museum, which would be sufficiently spacious and catholic to deal with such problems. Notwithstanding his criticisms, as a museum man himself he believes firmly in the importance of the museum as a technological laboratory, forming an essential part in a school of ethnology. While anthropologists will warmly endorse his plea for a national anthropological museum, they will trust that his anticipation of its foundation before the close of the present century is a playful euphemism for "at no distant date".

Proposed Rhodes-Livingstone Memorial

TO mark the jubilee of the foundation of the two Rhodesias by Cecil Rhodes in 1890 and the centenary of the setting out of David Livingstone for Africa in 1840, it is proposed to found a Rhodes-Livingstone Institute for Central African Studies in Northern Rhodesia. The main purpose of the Institute will be the study of the effect on native African society of the impact of European civilization and the urgent problem of establishing permanent and satisfactory relations between native and non-native. The proposal has the support of the Archbishops of Canterbury and York, the Right Hon. W. G. A. Ormsby-Gore, Lord Lugard, Lord Hailey, Dr. Henry Balfour, Sir William Bragg and others. It is proposed to purchase at a cost of £15,000 the premises now housing the Museum at Livingstone, the old capital of Northern Rhodesia, with the adjoining old Government House. The Museum contains objects of historical interest relating to David Livingstone and the nucleus of an important ethnographical collection. It was formed by the Government of Northern Rhodesia with assistance from the Beit Railway Trust, the Royal Geographical Society, the Scottish National Memorial at Blantyre and a number of individual benefactors. The premises will be vested in a trust, which will be responsible for administration and financial control. As a preliminary to the foundation of the Institute and the incorporation in it of the existing Museum, the Government of Northern Rhodesia has appointed an expert in applied anthropology, to whom an assistant will be added later if funds permit. Although the Rhodesian Government will bear its full share of the cost, an

appeal is made for contributions towards the capital cost of the Institute and the endowment of the Trust to enable admirers of Livingstone and Rhodes to give material expression of their interest in them and the future of the country with which they were connected. Contributions may be directed to any branch of Barclay's Bank or the Standard Bank of South Africa.

British School of Archæology at Athens, 1935-36

IN accordance with the new arrangement for the publication of the "Annual of the British School of Archæology at Athens", the formal matter, which includes the report of the director covering the activities of members of the School during the year, the accounts, and the summary of archæological operations in the Greek area of the eastern Mediterranean in the preceding year, will in future be issued separately to subscribers, the report for the session 1935-36 being the first occasion on which the decision of the Committee takes effect. In the chronicle of the session precedence is taken by a reference to the lamented and untimely death of the director, Mr. Humfrey Payne, on May 9, 1936. Mr. A. H. G. Megaw, who took charge of the School as acting director, left in the following July to take up his duties on appointment as director of antiquities in Cyprus. Owing to the temporary closing of the British School of Archæology at Rome, a number of its students worked in the School at Athens. Excavations by members of the School were carried on at Monasteri in the Perachora, at Siphnos and at Trapeza in eastern Crete. Miss W. Lamb excavated at Kusura in Anatolia. Supplementary excavations in the Heræum of Perachora, which had been planned by Mr. Payne, were postponed until the following season. The manuscript of the account of the excavation of this important site was left in an advanced state by the late director, and it is anticipated that publication of the first volume will not be long delayed. In the chief descriptive notes of the activities of the School reference is made to some interesting discoveries in Crete. Although no further investigation of the Roman villa was possible, surface finds east of the basilica indicate that this was an important residential quarter of the Roman town in the first and second century A.D.

Speleological Conference at Bristol

FURTHER particulars of the second annual conference of the British Speleological Association to be held at Bristol on July 23-26 next (see NATURE, May 29, p. 919) are now available in the advance programme which has been issued. Through the hospitality of the University of Bristol the conference and exhibition will be held in the Great Hall of the University. The exhibition will include contributions from nearly all the important caves in the world, as well as some unique illuminated transparent photographs. Probably the largest and most valuable collection of 'Blue John' will be exhibited. On the evening of July 24 an illustrated public lecture will be delivered by the Abbé Breuil on some aspects of the

French and Spanish caves. Among the lectures announced is a brief account by Mr. C. R. Hewer of some of the caves to be visited on the Continental tour on July 27-August 7 when members will have the opportunity of visiting caves not as a rule accessible to the public. At Nurnberg, after a visit to the Museum for Prehistory, the party will proceed to Teufelhöhle, Maximiliansgrotte, and other caves of archæological, geological and palæontological importance at Pottenstein, where also a mesolithic cave shelter has been especially excavated for the visit by the "Gaukulturamt". At Brno, Czechoslovakia, Prof. C. Absolon will conduct the party over the Museum, with its unique collection of archæological finds from the Moravian caves, which include remarkable examples of palæolithic plastic art; and in the afternoon of the same day the caves, which are the centre of the great mammoth hunters' culture of Moravia, will be visited. Passing through Vienna the party will proceed to the famous 'Drachenhöhle' from Mixnitz, the Lower Lurhöhle from Peggau and the Eisriesenwelt—ice cave from Werfen, the last place of call being Salzburg.

The Swiss Society of Natural Sciences

THE recent issue of the *Verhandlungen der Schweizerischen Naturforschenden Gesellschaft* contains an account of the annual meeting of the Society held at Solothurn in August 1936 and also reports of the work of the previous year. The object of the Society is to promote the study of all branches of natural science in Switzerland. Between the annual meetings for the presentation and discussion of papers, the work of the Society is carried on by a number of commissions. Some of these are concerned with the administration of endowments, while others undertake field work in various sciences. The latter are financed partly from members' subscriptions, but mainly from Government grants. Among the commissions performing work of national importance is the Geological Commission, which is engaged in the publication of a geological survey of Switzerland on scales of 1:25,000 and 1:200,000. In addition to the purely scientific commissions, there is a Commission for the Preservation of Nature, which is doing valuable work in preserving sites of scientific interest or scenic beauty, as well as in promoting legislation for the protection of forms of wild life which are in danger of extermination. Besides administering Government research grants, the Society also acts as the official representative of Switzerland on international scientific unions, and the volume under notice contains the reports of the Swiss delegations to a number of such unions.

THE presidential address at the annual meeting in 1936 was given by Dr. Karl Dändliker, who took as his subject, "Birth-Rate Decline and Surplus". He showed how, in spite of the excess of births over deaths, the population of many countries in Europe is bound to decrease before long. A paper was read by H. Brockmann on "Swiss Farm-Houses", in which two types of buildings were distinguished: one type

has evolved from the use, by primitive man, of caves as shelters, while the other has evolved from tree shelters. Other papers read before the general meeting were "Inheritance by Labile Genes", by A. Ernst; "The Sting of the Bee", by M. Roch; "Ontogenesis of the Bird as a Problem in Evolution", by A. Portmann. These papers are all printed in full. In addition, abstracts are given of some 150 more specialized papers, dealing with nearly all branches of science, which were presented to the sectional meetings of the Society.

Royal Cornwall Polytechnic Society

THE one hundred and third annual report of the Royal Cornwall Polytechnic Society, besides containing the usual list of members, financial statements and an account of the work of the Falmouth Observatory, has several contributions of general interest. One of these is by Miss R. Beckett, who, in a paper on "Public Library Service", traces the growth of public libraries due to the Library Acts of 1850, 1855 and 1919. The Act of 1850 limited the rate to be levied to $\frac{1}{2}d.$ in the £ and that of 1855 to $1d.$ These sums proved quite inadequate, but it was not until 1919 that the penny rate limitation was abolished. In practice to-day, the average expenditure is $1s. 4d.$ per head of population, though some authorities expend as much as $2s. 6d.$ In another contribution, Mr. S. Furze deals at length with the operations involved and the machinery used in tin dressing, while in a third, Mr. J. H. Rowe gives the early history of Hayle Foundry, which was founded by John Harvey (1730-1803) and developed by his son Henry Harvey (1775-1850). This foundry was the earliest in Cornwall, and became ultimately the most important engineering works in the west of England. The well-known engineer Arthur Woolf (1766-1837), the pioneer of the compound steam engine, was at one time superintendent of this works, and it was there that he built some of the finest Cornish pumping engines of the time. The history of the Royal Cornwall Polytechnic Society inevitably recalls the Fox family, and the report has a tribute to Mr. Wilson Lloyd Fox, who died on February 10, 1936. He gained one of the Society's prizes in 1860, became a member in 1865, served as president in 1922-24, and was secretary of the Committee of the Falmouth Observatory from 1877 until 1931.

Intelligence, Character-training and Civilization

A LUDWIG MOND LECTURE entitled "Intelligence and Civilization", delivered at the University of Manchester last October by Prof. G. H. Thomson, of the University of Edinburgh, has been published in the first issue of the new *Journal of the University of Manchester*. After a preliminary discussion of some aspects of recent researches in the field of intelligence measurements, Prof. Thomson proclaims his belief (which was also H. T. Buckle's) that the history of the advance of civilization has been the history of the conquest of the world by intelligence. He preaches the salvaging of civilization "through the cultivation by an education proper to each of

the intelligence of all". Of character-training he is profoundly distrustful. A clear vision of truth is, he assumes, to be attained solely through cultivation of the intelligence and "the schoolmaster's sole business is to lead his pupils to see truth clearly . . . and . . . that is the only character-training the school may lend itself to, if it is to refrain from serving party or class . . . but is to serve civilization". He does not think much of civilization's debt to the poets ("far more dangerous than scientists"), notwithstanding that he holds intelligence to be based on imagination, and he makes a point of registering disagreement with Earl Baldwin's hope, confided to the Congress of Universities of the Empire, that from those universities may presently come forth "poets who will inspire Europe and the world once more with a sense of unity and a sense of freedom".

The Utilization of Wood as Fuel for Motive Power

IN the *Bulletin* of the 'Société d'encouragement pour l'Industrie Nationale' of January is printed an abstract of a paper by R. Vaultrin on the utilization of wood as fuel for motive power. Towards the end of the Great War, the French Ministry of Inventions made experiments on carrying heavy loads between Paris and Rouen by motor-lorries provided with suitable gas generators using wood for fuel, but the results obtained were not good. In 1928, after a further rally with 'camions à gazogène', the problem was completely solved; but at that time the price of the wood fuel was too high to make it profitable. A notable rally was made in 1930 between Paris and Rome, crossing the Alps and the Apennines, and another was made through the Landes where resinous fuel was used and found suitable. Recent results for tourist vehicles gave 50 miles per hour consuming about 70 lb. of firewood, costing six francs for a sixty miles run. Heavy motor-lorries can run at 30 miles per hour, the cost for sixty miles being fifteen francs. In France, there is an annual over-production of thirteen million cubic yards of firewood. This would be sufficient for 60,000 motor-vehicles using gas generators. At the moment, the difficulty is to obtain, on the road, supplies of suitable wood with constant humidity. This double problem has been solved between Frankfort and Cologne. In France there are already large stores on a 'national' road, and all the main routes on the east are being supplied with stores. The control of the humidity of the wood distributed is being studied.

Electric Furnaces

DURING last year the use of electricity for the melting and heat treatment of iron and steel in Great Britain considerably increased. There has been a revival in the demand for arc furnaces, a number of which, varying in capacity from 500 to 6,000 kilowatts, are being installed. In the *Electrical Review* of April, Mr. D. Campbell states that the furnaces ordered from a single manufacturing company during last year would consume about a 100 million electric units a year. The cost of the annual power bill for these furnaces alone would be about £200,000. A

furnace of 6,000 kilowatt capacity, probably the largest electric melting unit in Europe, has just begun operation in Sheffield. Within its small area of furnace hearth (13 ft. diameter), as much energy is consumed per day as the aggregate loads of Cambridge, Salisbury and Tonbridge. Unfortunately, the requirements of larger and interconnected power stations make it essential to install higher rupturing capacity switch-gear, and this constitutes a heavy charge on small firms which may want to use electric furnaces. Seeing that the cost of the energy consumed by the furnace during its average life (ten years) is about thirty times the original cost of the complete installation, the companies should offer attractive conditions to steel manufacturers. The extreme purity of arc furnace steel owing to the absence of slag inclusions is now generally recognized, and for many types of forging this steel is specified. The choice between high-frequency furnaces and arc furnaces is difficult to make. Although the capital expenditure for high-frequency furnaces is much higher, yet when melting operations only are required they are cheaper to work.

Astronomy in Japan

THE Kyoto Imperial University has accepted a donation equivalent to about £10,000 from the Osaka Electric Railway Co. towards the building of an observatory on the southern peak of Ikomasan at a height of 640 metres. The observatory will include a main building with a 9-metre dome, a solar laboratory, housing for a reflector and a dormitory. The equipment of the solar department of the Kwasan Observatory is to be transferred to this new site, in addition to other instruments including the 80-cm. Tomkins reflector. Later a large museum devoted to astronomical exhibits and those of allied sciences will be built near the Ikomasan Observatory. Prof. Yamamoto will be the director of the group. The Kwasan Observatory will then become a purely academic institution. The Osaka Municipal Electric Museum, which has recently been completed, includes a Zeiss planetarium, which is installed under an 18-metre dome on the sixth floor of the Museum. *Bulletin* No. 326 of the Kwasan Observatory directs attention to a daily series of sun-spot observations made for fourteen years by Mr. Katue Misawa, whose failing eyesight now prevents the series from being carried on. The observations, which have been made regularly under excellent weather conditions, have been of great use in supplying data with the minimum delay to Japanese investigators. Observations of the zodiacal light are receiving special attention in Japan, and it is planned to establish a special observatory at Onomiti, Hiroshima-Ken, at a height of 150 metres. The observed longitude of the Kwasan Observatory, deduced from 74 observations made with the 90 mm. Bamberg transit in conjunction with the reception of Greenwich wireless time signals, is $-9^{\text{h}} 3^{\text{m}} 10.315^{\text{s}} \pm 0.002^{\text{s}}$ or $E. 135^{\circ} 47' 34.72'' \pm 0.03''$. The elements of latitude variation for the epoch 1934.0-1935.9 computed by Dr. Kimura from data provided by five northern stations are given in *Bulletin* No. 322.

Hygiene in the Bacon Factory

WITH this title, *Bull.* No. 1, published by the Bacon Development Board, Thames House, London, S.W.1 (1s.), lays down certain standards of sanitation as a condition of every licence to produce bacon, and describes in some detail a system of sanitation which, if adhered to, will assist curers to comply with the conditions of their licence, and help them, in their own interests, to reduce the risk of spoilage of their products. The construction, maintenance and equipment of the factory are first discussed, after which the daily and the periodical cleaning of the premises are described. Next, the keeping of the meat and bacon clean and wholesome, and the personal hygiene of the employees are dealt with. Data are given in an appendix upon sources and reduction of contamination and the use of sodium hypochlorite as a disinfecting agent.

Brown-Firth Research Laboratories

A BROCHURE of some seventy pages deals with the equipment and work of the Brown-Firth Research Laboratories in Sheffield. The various types of research undertaken are described briefly, and the apparatus used is illustrated. A long list of original papers which have been published is appended, together with a catalogue of books, manuscripts and reports available in the library. To all who are concerned in any way with the development of modern steels, this publication cannot fail to be of interest.

1851 Exhibition Studentships and Scholarships

THE science scholarship committee of the Royal Commission for the Exhibition of 1851 has recently awarded the following senior studentships and overseas scholarships, upon the recommendations of the universities and other institutions named: SENIOR STUDENTS. Dr. H. J. Bhabha (University of Cambridge), for research in theoretical physics at Cambridge; Dr. H. N. Rydon (Imperial College of Science and Technology), for research in organic chemistry at Oxford; Dr. J. L. Harley (University of Oxford), for research in mycology at Oxford; Dr. A. H. S. Holbourn (University of Oxford), for research in experimental physics at Oxford. A fifth Studentship was given to Dr. T. S. Westoll, who was a palaeontologist recommended by University College, London, but he has been appointed to a lectureship at Aberdeen and therefore will not take up the award. OVERSEAS SCHOLARSHIPS. *Canada*: Mr. A. J. C. Wilson (Dalhousie University, Halifax), for research in physics at the Massachusetts Institute of Technology and the University of Cambridge; Mr. D. M. Ross (Dalhousie University, Halifax), for research in experimental zoology at the University of Cambridge; Dr. H. Rudoff (McGill University, Montreal), for research in organic chemistry at the University of Oxford; Dr. J. L. Morrison (McGill University, Montreal), for research in physical chemistry at the University of Cambridge; Mr. A. G. Ward (Queen's University, Kingston), for research in physics at the University of Cambridge. *Australia*: Mr. R. D. Hill (University of Melbourne), for research in physics at

the University of Cambridge; Miss K. L. Prendergast (University of Western Australia), for research in palaeontology at the University of Cambridge. *New Zealand*: Mr. I. Lauder (University of New Zealand), for research in physical chemistry at the University of Manchester. *South Africa*: Mr. F. Sebba (University of Cape Town), for research in inorganic chemistry at the Imperial College of Science and Technology. *Irish Free State*: Mr. D. A. Webb (Trinity College, Dublin), for research in zoology at the University of Cambridge; *India*: Mr. N. S. Nagendra Nath (Indian Institute of Science, Bangalore), for research in theoretical physics at the University of Cambridge.

THIS is the first occasion on which a scholar from India has been included in the Overseas scheme of the Royal Commission for the Exhibition of 1851; and the award of the scholarship has been made possible by the action of H.M. Treasury in extinguishing the balance of the liability for contributions to the cost of new buildings for the Science Museum. The following preliminary selection committee was appointed by the Government of India to sift applications in India for the scholarship: Mr. J. E. Parkinson, Educational Commissioner with the Government of India (chairman); Dr. S. S. Bhatnagar, professor of physical chemistry, Punjab University; Sir C. V. Raman, director of the Indian Institute of Science, Bangalore; Dr. Birbal Sahni, professor of botany, Lucknow University. The names of three candidates for the scholarship were submitted by the committee to the Commissioners, who decided on June 30 to award the scholarship to Mr. Nath. In addition, it is worth mention that though Indian students, like all other British subjects, have always been eligible for Senior Studentships, if recommended by a university in the United Kingdom, Dr. H. J. Bhabha is the first native of India to be awarded such a studentship. He has made several original contributions to the correspondence columns of NATURE and is well known among workers in theoretical physics.

Rockefeller Travelling Fellowships in Medicine

THE Medical Research Council has awarded Rockefeller fellowships to the following for the academic year 1937-38: D. L. C. Bingham, clinical tutor, Surgical Outpatient Department, Royal Infirmary, Edinburgh; E. G. L. Bywaters, assistant clinical pathologist, Middlesex Hospital, London; P. R. Evans, registrar, Medical Diseases of Children, King's College Hospital, London; J. G. Sclater, tutor in clinical medicine, Royal Infirmary, Edinburgh; Dr. E. F. Scowen, assistant director, Medical Professorial Unit, St. Bartholomew's Hospital, London; Dr. C. H. Stuart-Harris, Sir Henry Royce research fellow in influenza, London; G. W. Hayward, resident medical officer, National Hospital for Diseases of the Heart, London. All these fellows propose to work at centres in the United States. In addition, the Rockefeller Foundation has awarded fellowships, on the recommendation of the Medical Research Council, to the following candidates in the

special field of psychiatry, neurology and related subjects: Dr. E. W. Anderson, medical director, Cassel Hospital, Peshurst; Dr. A. Kennedy, assistant medical officer, Maudsley Hospital, London; A. S. Kerr, surgical registrar, Royal Infirmary, Liverpool; Dr. D. J. Williams, resident medical officer, Hospital for Nervous Diseases, Maida Vale, London; Dr. A. F. Rawdon-Smith, senior student, Royal Commissioners for the Exhibition of 1851, working in the Psychological Laboratory, University of Cambridge. Dr. Anderson proposes to work in Germany, the others at centres in the United States.

Announcements

THE following have recently been elected honorary fellows of the Royal Society of Edinburgh: *British*: Dr. W. T. Calman, lately keeper of zoology, British Museum (Natural History); J. L. Baird, inventor of the 'Televisor'. *Foreign*: Prof. C. U. Ariëns Kappers, director of the Central Institute of Brain Research, Amsterdam, and professor of comparative neurology in the University of Amsterdam; Prof. M. T. Bogert, professor of organic chemistry in Columbia University, New York; Prof. Max Planck, emeritus professor of theoretical physics and director of the Institute for Theoretical Physics in the University of Berlin.

DR. G. W. SCOTT BLAIR, of the physics department, Rothamsted Experimental Station, has been appointed head of the chemistry department at the National Institute for Research in Dairying, Shinfield, near Reading. Dr. Scott Blair, who is a chemistry graduate of the University of Oxford, joined the Rothamsted staff in 1926. He has worked on the physico-chemical properties of various agricultural materials such as soil, flour, honey and cheese. During one part of his Rothamsted service he held a Rockefeller Fellowship at Cornell University.

DR. F. W. EDWARDS has been appointed a deputy keeper in the Department of Entomology of the British Museum (Natural History). Dr. Edwards was born in 1888 and entered the Museum service in 1910. He is an authority upon Diptera. He undertook very successful collecting expeditions on behalf of the Museum to Patagonia in 1926-27 and to East Africa in 1934-35, as well as several smaller expeditions.

THE fourth Congress of the Medical Women's International Association will be held on July 13-18 at the McEwen Hall in Edinburgh. Further information can be obtained from the Local Congress Secretary, 2 Chester Road, Edinburgh.

MESSRS. JAMES TREGASKIS AND SON, 66 Great Russell Street, London, W.C.1, have issued a catalogue of old works on medicine and biology (Caxton Head Bulletin 21). It includes a copy of the rare first edition of Darwin's "Origin of Species", Gesner's "Treasure of Eponymus" (1559), Laennec's "Traité de l'auscultation mediate" (Ed. 4, 1837), the "Opera" (1582) of A. Paré, the great medieval surgeon, and other rare volumes.

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. 71.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Heat Conduction in Liquid Helium

IT was found by Rollin¹ and by Keesom and Keesom² that liquid helium II shows an extraordinarily high heat conductivity, of the order of

the capillary. For example, at 2.10°K ., a level difference of 1 cm. corresponds to a temperature difference of 1.32×10^{-3} deg. Since, on the other hand, the heat flow through the capillary is equal to the heat produced in the wire, one can determine the conductivity.

It is essential for this method that one should actually obtain equilibrium, but it is easily estimated from the observed conductivity that equilibrium should be established in a fraction of a minute, and it was indeed observed that the level followed a change in the current very rapidly and reversibly. It is also easy to see that the heat conduction in the glass, in the leads carrying the current, etc., is negligible. In order to avoid convection, the warm end of the capillary was arranged to be lower than the cold end (the expansion coefficient of helium is negative).

Preliminary experiments showed the unexpected result that the conductivity depends on the temperature gradient. We therefore used an arrangement in which the level difference could vary from 12 cm. to about 0.3 mm., and measured the heat flow as a function of the temperature difference ΔT between the ends of the capillary. In this case the capillary was 16.8 cm. long and had an internal diameter of 1.45 mm. The results are shown in Fig. 1, for bath temperatures of 2.06° and 1.34°K . It is clear that the heat flow is far from being proportional to ΔT , even for the lowest temperature differences we used. The ratio of heat flow to temperature gradient, which one may call conductivity, increases with decreasing ΔT . It reaches the value 1.1×10^4 cal./deg. cm.sec. at $\Delta T = 5 \times 10^{-5}$ and $T = 2.06$. It appears, however, to rise still further and a refinement of the method is required to decide whether it tends to a finite value as ΔT tends to 0.

Qualitative measurements at a number of different temperatures between 1.34° and 2.19° showed the same general behaviour. At constant ΔT , the

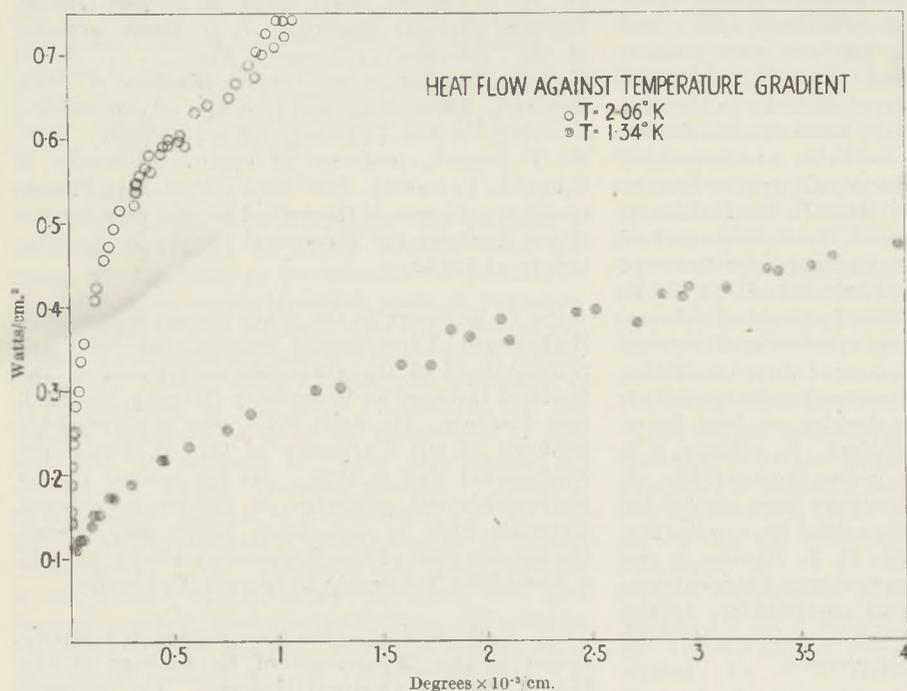


Fig. 1.

190 cal./deg.cm.sec. We have measured the heat conductivity with the following method, which is essentially a combination of a vapour-pressure thermometer with a liquid-helium manometer.* (The method was developed in discussion with Dr. J. D. Cockroft.)

An evacuated glass vessel is immersed in a helium bath. It contains a vertical cylindrical bulb, the bottom of which communicates with the outer bath through a glass capillary. The bulb also contains a heater wire through which a current can be passed. This current is so adjusted that part of the helium in the bulb evaporates, and only part of the bulb is filled with liquid. The level of the liquid is observed in a telescope and its height compared with the level of the bath. In equilibrium, the difference in height is such that the difference in hydrostatic pressure is equal to the difference in vapour pressure. In this way one obtains the temperature difference between the bulb and the bath, and this is practically also the temperature difference between the two ends of

conductivity is relatively small near the λ -point (2.19°), reaches a maximum in the neighbourhood of 2.0° and decreases again at lower temperatures.

We cannot suggest an explanation for these results, for which there is no analogy in the behaviour of other substances. It seems impossible, however, to account for them by any errors in the experimental method; the effect seems actually to be a property of the liquid helium II.

J. F. ALLEN.
R. PEIERLS.
M. ZAKI UDDIN.

Royal Society Mond Laboratory,
Cambridge.
June 22.

¹ *Physica*, 2, 557, (1935).
² *Physica*, 3, 359, (1936).

Analysis of Ternary Gas Mixtures by Thermal Conductivity Measurements

It frequently happens in the course of exchange reactions with deuterium and hydrogen that a third gas is present initially, or is produced during such experiments (for example, nitrogen in exchange reactions with ammonia and deuterium). If this gas is non-condensable in liquid air, the deuterium content of the gas cannot be estimated by the convenient thermal conductivity methods, unless a trap cooled with liquid hydrogen is employed to freeze out the third constituent of the mixture. The gases concerned are oxygen, nitrogen, carbon monoxide and methane and the inert gases. The only alternative method is to burn the gases and measure the deuterium content of the water so produced.

The thermal conductivity method described below surmounts this difficulty. Its operation depends on the fact that the thermal conductivity of hydrogen decreases rapidly below 200° K., owing to the decrease in rotational specific heat of the molecule. The thermal conductivity of deuterium, on the other hand, only decreases slowly, since the rotational specific heat remains practically constant down to

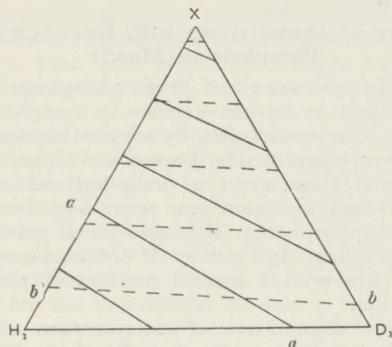


Fig. 1.

about 80° K. For example, at 250° K. the ratio of the thermal conductivities is $1.384 : 1$; at 75° K. it is $1.095 : 1$. Consider now a ternary mixture containing hydrogen, deuterium and a third gas (X). At high temperatures (c. 250° K.) a whole series of mixtures will have the same thermal conductivity—as is exemplified by the full lines on the ternary

diagram (Fig. 1). At 75° K., however, the isothermal conductivity lines will be more nearly parallel to the hydrogen-deuterium side of the triangle, as is indicated by the dotted lines. To perform an analysis of an unknown mixture, then, it is only necessary to measure the thermal conductivity at these two temperatures: if, for example, the respective thermal conductivities correspond to the lines aa and bb , the point of intersection at once gives the composition of the mixture.

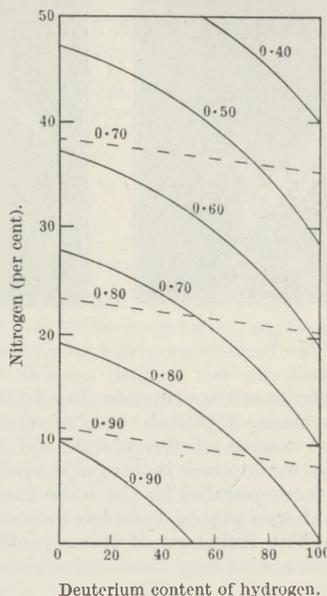


Fig. 2.

In practice, the analysis may be carried out by compressing the mixture to a standard pressure, for example, 50 mm., into a micro thermal conductivity cell, of volume 0.05 c.c. (that is, requiring about 0.01 c.c. gas at N.T.P.), dipping into liquid air and attached to the compression capillary of a McLeod gauge¹. The voltages required to maintain the filament at the two chosen temperatures are determined. The isovolt lines obtained for hydrogen-deuterium-nitrogen mixtures are shown in Fig. 2. The filament temperature was 300° K. and 110° K. in the case of the full and dotted lines respectively. The observed voltage value, relative to that required for pure hydrogen, corresponding to each isovolt line is indicated. The observed curvature of the high-temperature lines is attributable to mixture effects. For mixtures of nitrogen-content not exceeding 50 per cent, the accuracy of the method is about 1 per cent deuterium.

It is evident that this method may be applied to any ternary mixture, one component of which is hydrogen and the other two, gases of different thermal conductivity. Mixtures of ortho- and para-hydrogen and a third gas may likewise be analysed.

J. L. BOLLAND.

Chemistry Department,
University,
Edinburgh.

H. W. MELVILLE.

Colloid Science Laboratory,
Cambridge.
May 21.

¹ Melville and Bolland, *Proc. Roy. Soc.*, in press.

Artificial Slip Formation in Crystals.

WHAT is the cause of the plasticity and low elastic limit of crystals? No satisfactory answer has as yet been found to this fundamental question in crystal

All the photographs show the artificially created slips in polarized light. The axes of the Nicols are parallel to the cube axes. The scratches are made in the direction (100) normally to the plane of the



Fig. 1.

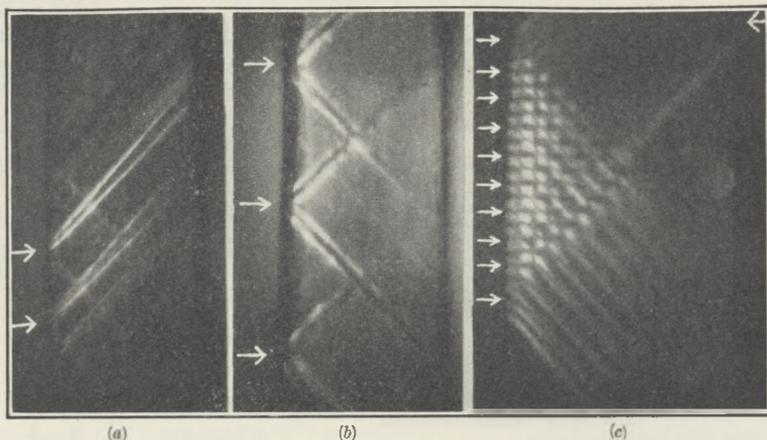


Fig. 2.

physics. The results of experiments, briefly described in the present note, establish one of the factors determining the course of the plastic deformation.

A scratch was made on a rectangular specimen of rock salt with faces parallel to the cube faces. The scratched crystal was placed between crossed Nicols and stretched. The influence of the scratch on the process of slip formation was observed with polarized light.

The main result may be summarized in the statement that a scratch is the source of the slip.

The gradual propagation of the slips beyond the region of the scratch, and their growth throughout the bulk of the crystal, were observed directly. The bright rays in Fig. 1, Fig. 2 *a* are artificially produced slips. They were especially pronounced when the scratches were made on specimens the original surfaces of which had been previously dissolved away.

The picture formed by the artificially produced 'slips' depends upon the experimental conditions. With different positions of the scratches on the surface of the crystal, we could obtain any desired slip patterns. Fig. 2 *b* corresponds to three parallel scratches at a distance of 5 mm. from each other. Fig. 2 *c* corresponds to 10 parallel scratches at a distance of 0.5 mm. from each other.

A number of details in the photographs may be noted, such as (1) the increased illumination in the parts lying along the locus of the intersection of the slips, with a straight line drawn at an angle of 45° to the axis of the specimen from the scratch (see Fig. 1, dotted in the upper ray); (2) the direction of the slips deviates considerably from 45° (see Fig. 2 *a*); (3) the interference of several scratches (see Fig. 2 *c*), etc. Fig. 3 shows a part of one of the rays reproduced in Fig. 1 at a greater magnification.

It appears that the plastic deformation of crystals cannot be explained by a simple slipping mechanism. The rupture takes place along the scratch. The process of rupture proceeds as follows: the surface defect gives rise to the appearance of slips, which in their turn lead to the development of a surface defect, which ends in fracture.

The state of the surface and local deformation are probably also of importance in twinning.

picture. The arrows indicate their position. The scratches were produced by means of a Martens sclerometer.



Fig. 3.

A detailed account of these experiments will shortly be published in the *Phys. Zeitschrift der Sowjetunion*.

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Coupling of Dismutations with Esterification of Phosphate in Muscle

THE disappearance of free phosphate during glycogenolysis in muscle extract is a striking phenomenon. One mechanism by which this occurs has recently been elucidated by Parnas and his colleagues¹, who showed that, even in long-dialysed extracts, phosphate and glycogen can react together giving hexosemonophosphate. This reaction is poisoned by *M*/100 phloridzin, but not by *M*/400 iodoacetic acid. We have observed a second method of phosphate esterification.

A certain dependence of esterification of carbohydrate upon dismutation has from time to time been observed, for example, by Meyerhof and Kiessling² in yeast and muscle extract, by Schäffner and Berl³ in yeast extract, and by Dische⁴ in red blood cells and hæmolysed blood. Dische mentions having found an increase in easily hydrolysable phosphate during this esterification, and suggested that the synthesis of adenylypyrophosphate might be an intermediate step. We now show that in the second method of phosphate esterification in muscle extract

the dismutation of triosephosphate with pyruvic acid (giving phosphoglyceric and lactic acids) is coupled with a synthesis of adenylypyrophosphate from adenylic acid and free phosphate.

As enzyme preparation we used extract of acetone muscle powder (rabbit) prepared according to Meyerhof's technique. In order to destroy adenylypyrophosphatase (the activity of which would have masked any adenylypyrophosphate synthesis) we kept the extract at 0° for five days before use; the extracts were also dialysed for four hours to remove any remaining traces of substrate. Typical results are given in Table 1. It will be observed that (1) iodoacetate, which inhibits the dismutation, inhibits also the esterification, (2) phloridzin does not inhibit either dismutation or esterification, (3) arsenate inhibits the esterification without affecting dismutation.

TABLE 1.

1 c.c. extract made up to final volume of 2.5 c.c.; with *M*/100 hexosediphosphate, *M*/50 pyruvate, *M*/50 fluoride, *M*/30 phosphate, *M*/200 adenylic acid, present in each sample. 0.4 mgm. co-enzyme present in each. 30 min. incubation at 37° C. The figures give increases and decreases in mgm.

Exp.		Lactic acid	Phosphoglyceric P	Inorg. P.	Pyro P.
IV		+ 1.58	+ 0.57	- 0.62	+ 0.66
V	No iodoacetate	+ 1.80		- 0.78	+ 0.72
	+ iodoacetate	+ 0.32		0	0
XVIII	No phloridzin	+ 4.56		- 0.51	+ 0.57
	+ phloridzin	+ 3.87		- 0.45	+ 0.66
XIX	No arsenate	+ 4.26		- 0.69	
	+ arsenate	+ 4.98		- 0.18	

Iodoacetate *M*/400; phloridzin *M*/100; arsenate *M*/75.

The dismutation of α -glycerophosphate with pyruvate, and the dismutation of hexosediphosphate to give glycerolphosphate and phosphoglycerate can be coupled with the phosphorylation of adenylic acid.

As regards the mechanism of the coupling, it can be said (1) that we have tested our extracts for adenylypyrophosphatase activity and found it to be nil. It seems, therefore, that the coupled esterification cannot be dependent upon a reversed reaction catalysed by this enzyme. (2) We have examined the ratio of lactic acid formed to phosphorus esterified. The results indicate that, according to the conditions, a greater or less proportion of the dismutation can be coupled with adenylypyrophosphate synthesis, but that however favourable the conditions, probably not more than one atom of phosphorus can be esterified per molecule of lactic acid formed.

This coupled esterification of phosphate probably plays an important part during the anaerobic recovery period when creatinephosphate is resynthesized, free creatine and free phosphate disappearing. Making use only of the Parnas mechanism of esterification of glycogen by free phosphate, and of the mechanism whereby phosphate is transferred from phosphopyruvic acid to adenylic acid, it seems possible to account for the resynthesis of only $\frac{1}{2}$ mol. creatinephosphate per mol. lactic acid produced. Both Meyerhof⁵ and Parnas⁶ have pointed out that Lundsgaard⁷ has actually observed a much greater synthesis than this—2 mol. creatinephosphate per mol. lactic acid formed. By taking into account the coupled esterification, synthesis of $1\frac{1}{2}$ mol. of creatinephosphate per mol. lactic acid can be expected. This is a value much nearer Lundsgaard's observed results. Further, during anaerobic recovery there is very little heat output; this can only be explained if the energy of dismutation is not evolved. We here

suggest that it is retained and used to make possible the endothermic synthesis of adenylypyrophosphate.

These considerations will be dealt with in detail elsewhere.

DOROTHY M. NEEDHAM.
R. K. PILLAI.

Biochemical Laboratory,
Cambridge.
June 3.

- ¹ Parnas and Baranowski, *Comptes rend. Soc. Biol.*, **120**, 307 (1935).
² Ostern, Guthke and Tersakowec, *Z. physiol. Chem.*, **243**, 9 (1936).
³ Parnas and Mochmacka, *Comptes rend. Soc. Biol.*, **123**, 1173 (1936).
⁴ Meyerhof and Kiessling, *Biochem. Z.*, **281**, 449; **233**, 83 (1935).
⁵ Schäffner and Berl, *Z. physiol. Chem.*, **238**, 111 (1936).
⁶ Dische, *Naturwiss.*, **22**, 776 (1934); **24**, 462 (1936).
⁷ Meyerhof and Lehmann, *Naturwiss.*, **23**, 337 (1935).
⁸ Parnas and Ostern, *Bull. Soc. Chim. Biol.*, **18**, 1471 (1936).
⁹ Lundsgaard, *Biochem. Z.*, **233**, 322 (1931).

An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin

IN our letter on "Coupled oxidation of ascorbic acid and hæmochromogens"¹, we had observed the formation of a hæmatin compound with an absorption band at 639 m μ during the coupled oxidation of pyridine-hæmochromogen and ascorbic acid. The same compound was formed by action of hydrogen peroxide on the hæmochromogen in presence of ascorbic acid. On reduction it gave a hæmochromogen with the bands of protohæmochromogen. From these observations we had concluded that the compound was a hydrogen peroxide compound of protohæmochromogen.

We have now found that the hæmochromogen, obtained by reduction of the compound with the absorption band at 639 m μ , is not protohæmochromogen, but a hæmochromogen of a new type. The position of its absorption bands is almost the same as the position of the protohæmochromogen bands (557.4 and 526.3 m μ), but the second band is stronger than the first, whereas in protohæmogen the first band is the stronger of the two. A hæmochromogen of a similar type is that of phylloporphyrin², a porphyrin carrying methyl on one methene group. By atmospheric oxygen the new hæmochromogen is rapidly oxidized to verdohæmochromogen, a hæmochromogen with open tetrapyrrolic chain. On splitting with hydrochloric acid in absence of oxygen, the new hæmochromogen gives rise to an oxyporphyrin, which resembles the oxyporphyrins obtained by H. Fischer and collaborators by action of hydrogen peroxide on porphyrins in concentrated sulphuric acid³. The absorption spectra of the oxyporphyrins of Fischer and also of our oxyporphyrin are similar to those of chlorins and rhodins, but whereas the copper and iron complex salts of Fischer's oxyporphyrins are also chlorin-like, the complex salts of our oxyporphyrin are of the phylloporphyrin type.

The most likely explanation appears to be that our hæmochromogen is the iron complex salt of an oxyporphyrin carrying a hydroxyl group on the α -methene group. By action of molecular oxygen on the oxyporphyrin-hæmatin, this carbon atom is then removed and the porphin ring opened. Fischer's oxyporphyrins carry their hydroxyls probably not on the methene group, but in the β -positions of a hydrogenated pyrrole nucleus⁴. The compound with the absorption band at 639 m μ is the ferric hæmochromogen of the oxyporphyrin, and not a hæm-hydrogen peroxide compound.

The conclusions, drawn from the existence of the supposed hydrogen peroxide compound with regard to the reaction mechanism of the coupled oxidation of hæmochromogen and ascorbic acid, remain, however, correct. Hydrogen peroxide plays a part in this reaction, transforming porphyrin-hæmatin into oxyporphyrin-hæmatin. There is also evidence in favour of the existence of a hæm-hydrogen peroxide compound during the reaction. Whereas catalase completely prevents the formation of the oxyporphyrin-hæmatin from hæmochromogen and hydrogen peroxide, catalase inhibits the formation of this compound (and of verdohæmochochromogen) by atmospheric oxygen only partially. The most likely explanation is that the 'nascent hydrogen peroxide' is protected from the action of catalase by its combination with the molecule with which it is to react afterwards (that is, the hæm), and that the partial inhibition of the reaction by catalase is due to a partial dissociation of the hæm-hydrogen peroxide compound and catalytic destruction of the hydrogen peroxide set free by the dissociation.

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Royal North Shore Hospital, M. NORRIE.
Sydney. May 15.

¹ NATURE, 139, 1016; 1937.

² Treibs, A., and Wiedemann, E., *Liebigs Ann.*, 466, 264 (1928).

³ Fischer, H., Halbig, P., Walach B., *Liebigs Ann.*, 453, 268 (1927).
Fischer, H., Gebhardt, H., and Rothhaas, A., *Liebigs Ann.*, 482, 1 (1930).

⁴ Fischer, H., and Lautsch, W., *Liebigs Ann.*, 528, 247 (1937).

Mechanism of the Glass Electrode

It is a well-known fact that new glass electrodes are not suitable for exact measurements until they have first been allowed to stand in water for some time. The continuous variation in potential observed with a new electrode may be connected with the property of the glass of taking up hydrogen ions. I have demonstrated¹ that hydrogen ions are exchanged for calcium and sodium ions in the glass electrode. The following experiments demonstrate the relation of the potential to the hydrogen ion uptake.

A series of bottles containing 2 gm. each of glass powder and 30 ml. of 0.1 *n* HCl were shaken at 25°. At different times bottles were removed and the liquid titrated with 0.1 *n* NaOH. From these data the amount of 0.1 *n* HCl (*C_t*) disappearing, equivalent to the amount of H taken up by the powder, after various lengths of time were found. The results of the titrations are given in Curve A (Fig. 1).

In order to determine whether measured potentials agree with those calculated from consideration of the chemical changes which occur, the following experiment was performed.

A spherical glass electrode was placed in each arm of a U-tube containing 30 ml. 0.1 *n* HCl and 2 mgm. glass powder in order to approximate the conditions in the experiment previously described. The inside of both electrodes and the outside of one of them had been in contact with 0.1 *n* HCl for a month, but the remaining outer surface had never been in contact with any solution. Silver wires covered with silver chloride were placed in contact with the inner liquid of both electrodes. The potentials of this system were measured periodically and the data obtained are represented by Curve B (Fig. 1).

In order to correlate the hydrogen ion uptake and the above-mentioned change in potential of new electrodes, the following assumptions have been

made. The initial hydrogen ion activity of the glass is assumed to be Pc_0 , where P is a constant, and c_0 is the number of hydrogen ions in the untreated glass per arbitrarily chosen unit of glass surface. At any time, t , after the immersion of the new electrode in hydrochloric acid, the number of hydrogen ions taken up is c_t , and the activity is now assumed to be equal

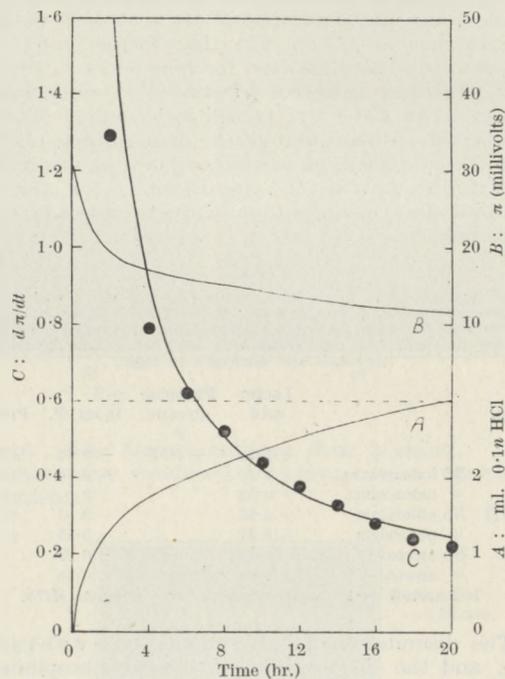


Fig. 1.

to $P(c_0 + c_t)$. Hence the variation of potential with time of the system is, when π is measured in millivolts, given by the equation:

$$\frac{d\pi}{dt} = \frac{RT}{F} \cdot 1,000 \frac{1}{c_0 + c_t} \frac{dc_t}{dt}$$

The values of $d\pi/dt$ and dc_t/dt at definite times are found graphically from Curves A and B in Fig. 1. The value 2.51 was found to be an approximation for c_0 . The details of the method of determining this value will be published elsewhere. This value means that 2 gm. of glass powder at the start of the experiment has a H ion content equivalent to 2.51 ml. 0.1 *n* HCl.

In Fig. 1, Curve C was constructed from the data obtained in the glass powder experiment and the points represent the values of $d\pi/dt$ derived from potential measurements.

From these experiments it appears that the suitability of a glass as an electrode depends upon its ability to exchange sodium and calcium ions for hydrogen ions. These experiments also confirm the hypothesis of Horowitz² published in 1923. From this point of view it should be possible to produce sodium, calcium and potassium electrodes by choosing a glass of the proper composition or a mineral of the permutit type. I am carrying out further investigations of these possibilities.

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May 12.

G. HAUGAARD.

¹ *Tidskr. Kemi og Bergvesen*, No. 4 (1937).

² *Z. Phys.*, 15, 369 (1923).

Controlled Cathode Sputtering

THE object of these experiments is to obtain accurate measurements relating to the phenomenon of cathode disintegration in gaseous discharges.

The apparatus consists essentially of a strong ion-source of the Lamar-Samson-Compton type¹, capable of delivering 2 milliamperes of singly-charged argon ions, and of an adjacent 'sputtering chamber' maintained at about 2×10^{-4} mm. mercury pressure, where the material to be tested is sputtered and measurements relating to that process are made.

The first objective is to obtain measurements of the amount of material sputtered per unit time as a function of the ion-current density and ion-energy. As shown in the diagram (Fig. 1), the ions emerging

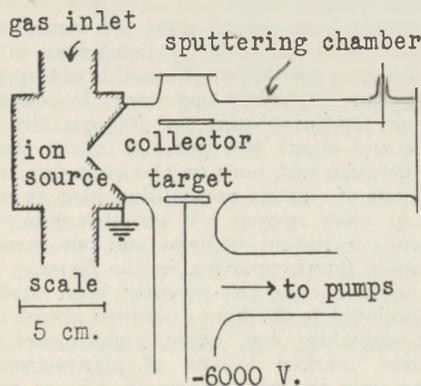


Fig. 1.

from the source (which is earthed) are allowed to impinge on and sputter a target maintained at a negative potential. Some of the material sputtered is deposited on a mica collector placed in front of the target, and supported by a horizontal fine quartz fibre. The weight of the deposit collected (a few milligrams) can readily be determined by observing the deflection of the fibre by means of a microscope. This allows measurement of the relative rates of sputtering. The total amount of material sputtered can be computed in cases where the law of angular distribution of sputtered deposit over a sphere is known².

The rate of sputtering of gold by argon ions of 6,000 volt energy has been determined. The sputtering rate is sufficient to deposit measurable amounts in $3\frac{1}{2}$ hours. With decreasing ion energy the rate of deposition decreases, and for ions of 2,000 volt energy, about 10 hours would be required to deposit a measurable amount. This is the maximum period over which the apparatus has been operated steadily. Because of the complicated nature of the apparatus, it seems impracticable to extend the time of the test. Therefore to obtain the rates of sputtering at lower voltages a construction of the sputtering chamber has been achieved, which still allows weight determinations, and in addition permits light transmissivity measurements of sputtered deposits.

The determination of the rate of sputtering of a given substance is complicated in some instances by a copious secondary electron emission from the bombarded target. Thus the apparatus is used at present in a somewhat modified arrangement for study of

this secondary electron emission from solid metals bombarded by argon ions.

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April 20.

¹ *Phys. Rev.*, **48**, 886 (1935).

² Seeliger and Sommermeyer, *Z. Phys.*, **93**, 692 (1935).

X-Ray Intensifying Screens adapted to Structure Analysis

THE intensifying screens in use for medical radiography cannot be employed to reduce times of exposure when working on tissue fibres, as they are not sensitive to the radiation used in structure analysis. However, Messrs. Ilford, Ltd., London, have now produced a screen, the Ilford Fluorazure intensifying screen (Levy-West), which proves to be very suitable for this purpose; this screen was put at our disposal by Mr. Chr. J. Bruno Wittgreffe, of the X-Ray Section, Ilford Co., to whom our best thanks are due for this kindness.

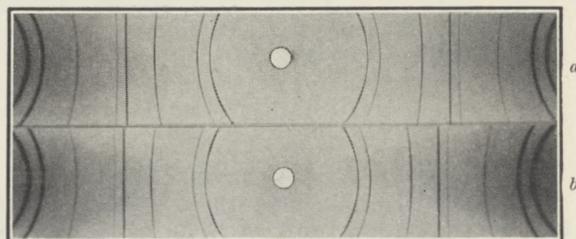


Fig. 1.

X-RAY PHOTOGRAPH OF A COPPER WIRE, TAKEN AT 40 kV. (a) ILFORD FILM WITHOUT SCREEN; EXPOSURE 45 MIN. (b) ILFORD FILM WITH A FLUORAZURE SCREEN AT THE BACK; EXPOSURE 15 MIN.

While we expected that increase of line width would counteract the advantages from eventual intensifying to such an extent that the photographs obtained would only be suitable for approximate work and not for exact measurements, we were quite astonished to find not only actual intensifying (3 times at 40 kV.) but moreover practically no increase of width, which seems a very important feature in the new screen. As appears from the photographs reproduced herewith (Fig. 1), it has proved possible to obtain films suitable for exact measurements. The photographs were taken with a Philips Metalix tube with copper-anticathode and a nickel filter of 0.01 mm. The Debye-Scherrer camera had a radius of 2.77 cm., while the diaphragm consisted of two pinholes 0.5 mm. diameter, separated by 6 cm. A copper wire of 0.6 mm. diameter was taken as a sample. Unless otherwise stated, the photographs were taken at 40 kV. and 15.5 m.amp.

First a photograph was taken on an Agfa-Laue film, the usual material for structure analysis. Proper blackening was obtained after 75 min. exposure. Then the experiment was repeated using an Ilford film. To get the same blackening as in the former case, an exposure of 45 min. proved to be necessary. The grain of the Ilford film is slightly coarser, but still within admissible limits (see Fig. 1, a). Thirdly,

we made a photograph on an Ilford film on the back of which a Fluorazure screen (Levy-West) was placed (Fig. 1, *b*). Identical results were now obtained with exposure reduced to 15 min., while there appeared to be practically no increase of width.

While at the ends of Fig. 1, *a*, the subdivision into α_1 and α_2 lines is fairly visible, Fig. 1, *b* still gives some slight evidence of their presence.

Other experiments were made at 30 kV. with an Ilford film at the back of which was a Fluorazure screen; the exposure was 15 min. While giving better contrast, blackening proves to be less; so that here the disadvantage seems to outweigh the advantage.

As usual in medical radiology, we also placed screens in front of and at the back of the film, but this gave, as might be expected, less blackening in the same time than with a screen at the back only; moreover, increase of width becomes manifest in that case.

We suggest that the use of Fluorazure screens is helpful in structure analysis; especially with the long exposure necessary in fibre research, it has evident advantages. Meanwhile, further research is being conducted along these lines.

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Living Animal Cases of Congenital Porphyrinuria

SOME time ago, in a single herd of grade short-horn cattle, running with one bull, on a farm in Swaziland, five living cases of congenital porphyrinuria were discovered. From the account given by the farmer, there had been seven other cases in the herd. Only one bull (a pure-bred, roan shorthorn)



Fig. 1.

PHOTOSENSITIZATION LESIONS ON BACK OF 'CEDARA',
A COW SUFFERING FROM CONGENITAL PORPHYRINURIA.

had been used during this period, and on an adjoining farm where he had also been employed, one case had occurred with certainty. The bull himself is normal but his dam was said to have been an unthrifty animal; possibly she, also, may have been a porphyrinuric.

The bull, four of the affected cattle and others, most of which are descended from him but normal, have been acquired by this Laboratory with a view to intensive study of the clinical features of the disease and its mode of inheritance. The fifth affected animal was slaughtered and a detailed chemical investigation carried out *post mortem*. In the forthcoming number of the *Onderstepoort Journal of Veterinary Science* (7, No. 2) papers are contributed by the writers of this note describing in full their findings. The two most severely affected animals each excrete about 0.6 gm. coproporphyrin and 0.06–0.07 gm. uroporphyrin daily, the others about half these quantities only. They show signs of photosensitization.

We also wish to record that a female calf which suffers from the disease has now been born at the Laboratory. It was the progeny of the bull with one of his normal daughters. The animal was seen approximately two hours after its birth, and the teeth were then distinctly pinkish-brown in colour. It is red-coated and although small is not apparently seriously handicapped in any way. It passes about 7.7 mgm. coproporphyrin per 100 gm. dry weight of faeces and about 40 γ per 100 ml. in the urine. A second heifer calf, born on the same day, sired by the bull out of another normal daughter, is perfectly normal in every respect. It excretes 0.41 γ coproporphyrin per 100 ml. of urine and but traces, only recognizable fluoroscopically, in the faeces.

Yet another case has recently been discovered, quite unrelated to the herd described above. This is a black-and-white cow about eight years of age. She shows marked lesions of photosensitization, involving only the white areas of skin on the back (see Fig. 1). This cow is in calf to a normal bull. She has reared one calf previously (apparently normal) but has also aborted.

A histopathological study of the bones and organs taken from the porphyrinuric animal which was killed is being made with the aid of an ultra-violet fluorescence microscope, and these findings will be published shortly. The bones, it may be mentioned, show on cross-section annular zones of pigment of varying intensity.

We believe these to be the first living cases of porphyrinuria in animals ever to be described, and the wealth of our material makes it highly probable that by breeding experiments we may be able successfully to elucidate the mechanism of inheritance of this very rare metabolic anomaly.

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Sex-Biology of the Oyster and the Salmon

THERE are similarities in the sex-biology of the oyster, *O. edulis*, and the salmon, *Salmo salar*, which may prove to be fundamental in character.

It is known that very young salmon remain in fresh-water as parr a variable time. Very rapid growth in the first year of life is often followed by development of the sea-migratory instinct, when the young fish acquires the attributes of, and departs for the sea as, a smolt. On the other hand, slow-growing parr may remain in fresh-water two, three or four years¹.

Just as certain smolts become sexually mature after one year in the sea and return as grilse to fresh-water to spawn, so in certain warm seasons in England, and more frequently in warmer and more southerly latitudes, do oysters mature as females at an age of one year². Other individuals of *Salmo salar* and others of *O. edulis* do not mature sexually until they are older, or rather other *O. edulis* certainly do not mature as females until they are older. In the case of this oyster there can be little doubt that environmental conditions govern the first onset of female sexual maturity, and it is considered a reasonable hypothesis to assume that the same conditions are operating on salmon.

In the oyster, all the factors operating in the attainment of sexual maturity at an age of one year are not known, but relatively high temperature (accompanied doubtless by a correlated type of metabolism), rapid feeding and rapid growth are known factors. But rapid feeding and growth result in the sea-migratory impulse in parr, and there are indications that the same factors may be operating in inducing sexual maturity in certain salmon after one year in the sea. It is known, however, that grilse are largely those fish which have had a long life as parr, and it is at this point where 'excess metabolism' or 'physiological repletion' does not quite account for the assumption of the sexual phase, as there appear to be good grounds for the deduction that younger fish may grow at a greater rate than grilse and yet not return to fresh-water to spawn. At least two primary factors are therefore involved: (1) relative adolescence and (2) rate—and perhaps nature—of metabolism.

The attainment of the adult organization in free-living animals may be presumed to be generally essential for the assumption of a preparation for female sexual maturity. In the oyster, again, it is stated that sexual maturity in a female may be delayed in colder localities until the animal is three years old³, although the oysters at this age may be far bigger than the one-year-old females found in the warmer hydrographical localities.

It would seem that in these considerations may be found a solution of the problem of the varying ages of sexual maturity in the salmon and the oyster. Among invertebrates, growth in spring may be relatively great before larvæ are produced and a much larger size attained than in the summer broods⁴, hence the temperature and rate at which good feeding occurs in these forms is more important for breeding than the amount of food consumed, and good growth may take place without the production of genital products. The oyster appears to conform to the same principle, but whether the same holds for the salmon must await further information. There is, however, nothing at variance with known biological phenomena in the possibility of homogenetic eggs from one salmon giving rise to smolts of different ages and also to either grilse or first spawning salmon of different ages.

The interesting facts regarding the high proportion of males among grilse, the change in proportion of grilse and salmon and the decline of grilse taken generally, are explicable on the varying opportunities smolt may have of feeding under different conditions in the sea. Loss of feeding grounds, for example, would entail a longer sojourn in the sea to build up the body requirements, so that the decline of hake, for example, might be correlated with the reduction in the proportion of grilse now taken; and in general,

unknown fluctuations of salmon food in the sea may be related to fluctuations in the sea-life of smolts.

Fundamental researches on the biology of insignificant invertebrates may therefore reveal principles applicable to important food fishes such as salmon and also—by a modification of the argument given above—also to herring.

Department of Zoology,
University, Liverpool,
June 4.

J. H. ORTON.

¹ Menzies, W. J. M., "The Salmon: its Life Story" (1931).

² Orton, J. H., NATURE, 139, 108 (Jan. 16, 1937).

³ Sparck, R., Report Danish Biol. Station, 30 (1924).

⁴ Orton, J. H., J. Mar. Biol. Assoc., 12, No. 2, 339-366 (July 1920).

Nocturnal Habits of *Platyedra gossypiella* Saunders

In the course of investigational work on *Platyedra gossypiella*, the pink bollworm of cotton, in the West Indies, observations were made on its nocturnal habits, concerning which but little is known. On the question of light attraction, for example, there has been a stalemate of opinions. Wilcocks¹ in Egypt found that both sexes came to light readily; while Busek² in Hawaii states that the moth is not attracted to light "but is on the contrary shy of all light, natural and artificial". "The idea", he writes, "that moths were attracted to light is based on very un-

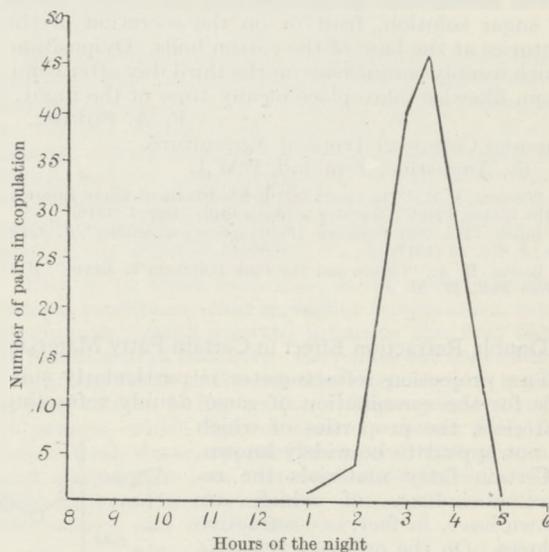
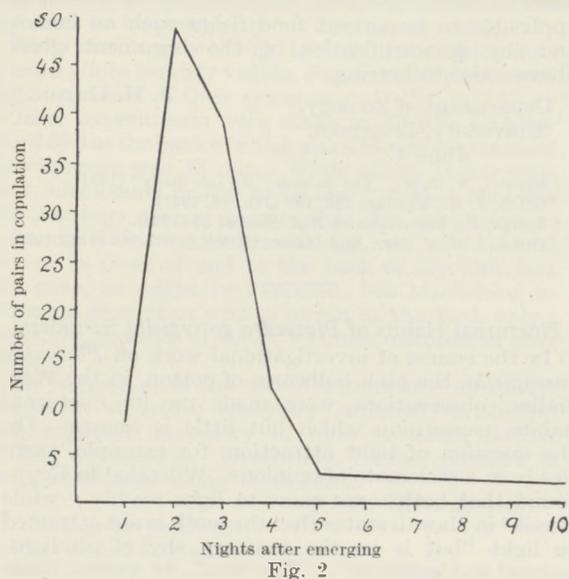


Fig. 1

satisfactory evidence and is probably due to a mis-identification of material collected in the traps"! In St. Vincent, B.W.I., light attraction is evident from 8 p.m. to 4 a.m., when it fails rapidly. By 5 a.m., though it is still dark, the moths are hiding as by day. In Egypt, Ballou³ found that there were always some moths that were not attracted. This difference has also been observed in St. Vincent and is not due to age, sex or condition. Attraction is strongest during the mating period. Wedded pairs are readily attracted, but in all cases prolonged exposure tires the response. There is no noticeable difference between the behaviour of long- and short-cycle moths.

Copulating moths take up the end-to-end position. Mating is curiously restricted to the last two hours of the active period (Fig. 1). The couples are docile

and do not readily separate. Copulation takes place soon after emergence (Fig. 2), lasts for 1-2 hours, and is not repeated.



The moths feed at all hours of the active period on sugar solution, fruit or on the secretion of the nectaries at the base of the cotton bolls. Oviposition, which usually commences on the third day after copulation, likewise takes place at any time of the night.

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Imperial College of Tropical Agriculture,
St. Augustine, Trinidad, B.W.I.

¹ Wilcocks, F. C., "The Insect and Related Pests of Egypt Injurious to the Cotton Plant", Ministry of Agriculture, Egypt (1916).

² Busck, "The Pink Bollworm (*Pectinophora gossypiella*)", *J. Agric. Res.*, 9, No. 10 (1917).

³ Ballou, H. A., "Cotton and the Pink Bollworm in Egypt", *West Indian Bull.*, 17, No. 4.

A Double Refraction Effect in Certain Fatty Materials

THE projection refractometer is particularly suitable for the examination of some doubly refracting materials, the properties of which do not appear to be widely known.

Certain fatty materials the refractive indexes of which are known have, in fact, two refractive indexes. On the ordinary refractometer in which the light is transmitted through the material to be tested, the border line of total reflection due to the higher index is not usually seen, since there is much greater contrast at the border line due to the lower index. The space between the two border lines is plane polarized, the vibrations taking place in a direction parallel to the border lines. Thus, these materials appear to behave as though they were doubly refracting.

It has been known for some years that soap gives these two border lines under certain conditions. Recently some other materials were investigated, and it was found that

vaseline, lanoline, rubber lubricant, ordinary yellow soap, and the pure green soft soap, all give the two border lines referred to. On the other hand, various thick lubricants give only one border line.

It was found that vaseline, lanoline and the rubber lubricant, if melted and dripped on to the refractometer prism, give only one border line, that due to the lower index; but if the material is then smeared while it is still upon the prism, thus removing any possibility of micro-crystals being orientated in a particular direction, the second border line appears, and in the case of lanoline treated in this way, there is a trace of a third border line. In the case of moistened yellow soap, the difference in refractive index is about 50 per cent greater than the difference between the ordinary and extraordinary rays of quartz.

The projection refractometer has a single horizontal prism surface upon which material is placed. Light from an internal source is totally reflected at the interface of the prism and the material being tested. None of the materials mentioned above gives a sufficiently sharp border line to allow of readings closer than the third decimal place.

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Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop

It has been found that the oil drops used in our investigation on the determination of the electronic charge show large variations in the time of descent, t_g , and ascent, t_f , with time, and consequently the greatest common divisor v_1 . This is true of all oils experimented with, such as Apiezon A and B, Nye's super-fine clock oil and others, except our newly prepared animal oil (which shows little or no change). Nevertheless, it makes necessary the careful study of the time variations of these three quantities. The results may be stated as follows:

There are four distinct classes of drops.

(1) 50 per cent of the total number are spherical drops which behave normally.

(2) With a few drops, collision of two unequal spheres forms a pear shape drop, showing very large

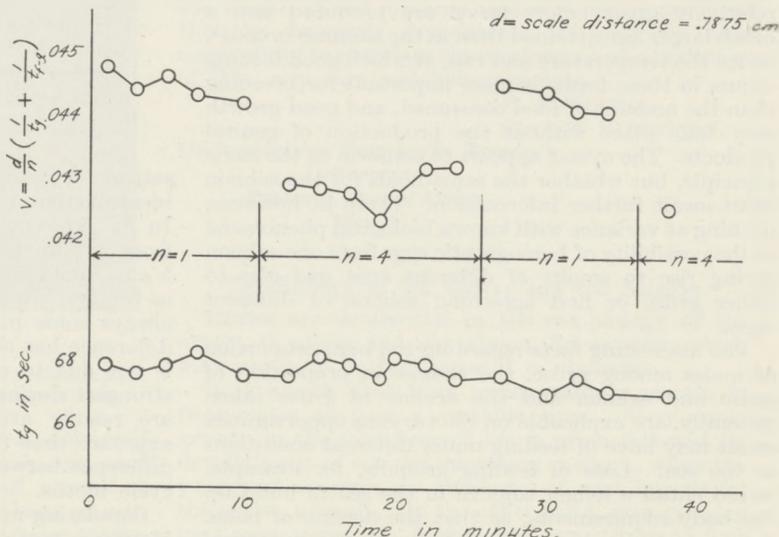


Fig. 1.

discontinuities in the curves. The resulting drop becomes a sphere within a short time.

(3) For 20 per cent of the drops t_g and t_f-g increase for the first five minutes at the same percentage rate. These drops are found to be oblate spheroids with eccentricity gradually decreasing with time, and becoming spheres.

(4) For 30 per cent of the drops, as shown in Fig. 1, while the time variation curve of t_g is very regular, that of the greatest common divisor v_1

shows discontinuities which depend upon the number of charges on the drop, and the greater the number the smaller the common divisor. This class of drop is stable for hours. They are presumably prolate spheroids.

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May 15.

Points from Foregoing Letters

THE heat conductivity of liquid helium II at 1.34° and 2.06° K. has been measured by Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, by means of a new method consisting essentially of a combination of a vapour-pressure thermometer with a liquid-helium manometer. The results show that the heat conductivity of liquid helium II depends upon the temperature gradient, an unusual behaviour for which, the authors state, they can offer no explanation.

A convenient method of analysing ternary gas mixtures, containing hydrogen as one component, by means of thermal conductivity measurements, is described by J. L. Bolland and Dr. H. W. Melville. The volume of gas required may be reduced to 0.01 c.c. at N.T.P., by using a suitable micro-conductivity cell.

Photographs showing slip-formation in crystals of salt the surfaces of which have been scratched and then stretched, are submitted by A. W. Stepanov. The photographs, taken in polarized light, show that the surface scratches give rise to slips; these in turn increase the surface defect, which ends in fracture.

From the effect of iodoacetate, phloridzin and arsenate upon the lactic acid formation in muscle extract, Dr. Dorothy M. Needham and R. K. Pillai deduce that the oxidation-reduction of triosephosphate with pyruvic acid is coupled with a synthesis of adenylypyrophosphate from adenylic acid and free phosphate. They suggest that this coupled esterification of phosphate may play an important part during the anaerobic recovery period in the muscle, when there is little heat output. The energy developed by the first reaction, they consider, may be taken up by the second.

A substance with absorption band at 639 μ , which Dr. R. Lemberg, B. Cortis-Jones and M. Norrie recently deemed to be a hydrogen-peroxide compound of proto-haemochromogen, appears, according to further tests by the same authors, to be the ferric haemochromogen of an oxyporphyrin carrying a hydroxyl group on the α -methene group.

A graph showing the amount of hydrochloric acid taken up by powdered glass after given periods of time, and another giving the change in electric potential of a new glass electrode with time, are submitted by G. Haugaard. From these, the author infers that the suitability of a glass as an electrode depends upon its ability to exchange sodium and calcium ions for hydrogen ions, and that it should be possible to produce sodium and calcium electrodes by choosing a glass of proper composition or a mineral of the permutit type.

An apparatus has been built at the Massachusetts Institute of Technology by Dr. Gregory Timoshenko for studying controlled sputtering of metals under the impact of positive ions. The apparatus in its present form allows accurate measurements of the rates of sputtering and of secondary electron emission from various solid metals bombarded by argon ions having an energy of 6,000–2,000 volts.

Photographs are submitted by Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst to show the usefulness of the Ilford 'Fluorazure' screen in shortening the exposure time needed to obtain X-ray photographic patterns of fibres for the analysis of their structure.

Several cases of animals suffering from congenital porphyrinuria, a rare disease in which porphyrin (a red decomposition product of haematin, but containing no iron) is excreted, are described by P. J. Fourie and Dr. Claude Rimington. Some of the animals are living, and the authors hope, by means of breeding experiments, to elucidate the mechanism of this peculiar metabolic anomaly, which also renders the skin of the animals sensitive to light.

Prof. J. H. Orton finds that, in the oyster, environmental conditions (that is, higher temperature, rapid feeding and rapid growth) influence the first onset of female sexual maturity. He points out that similar conditions result in the sea-migratory impulse in parr (young salmon in fresh-water). The sexual maturity in salmon, which induces them to return from the sea to fresh-water, appears to depend both upon age and size, which is a factor of environment. This may explain the varying ages of sexual maturity in the salmon and the oyster.

The nocturnal mating habits of the pink bollworm of cotton (*Platyedra gossypiella*) are described by F. A. Squire. The author points out that the moths are attracted by light only during certain hours of the night, which may account for the divergence of opinion expressed on the subject by different observers.

L. Bellingham finds that vaseline, lanoline, rubber lubricant, and certain soaps, have two refractive indexes when tested by the projection refractometer. If melted and dripped on the refractometer prism, the lower index is observed, but if smeared upon the prism so as to prevent orientation, the higher index becomes effective.

During experiments on the fall of electrified oil drops (for the determination of the electronic charge), Y. Ishida has identified four types of drops, according to their shape and the variation in the time of their fall.

Research Items

Prehistoric Archaeology of North-Eastern New Mexico

PROF. E. B. RENAUD, in his ninth report on the archaeological survey of the High Western Plains, which he is carrying out on behalf of the University of Denver, deals with the north-eastern area of New Mexico, which has been visited in summer field-work on various occasions since 1930. For archaeological purposes, the region has been divided into six districts covering the three areas of drainage—the Dry Cimmaron, the Canadian River, and the Pecos River. The region as a whole contains a large number of archaeological sites, of which 211 have been reported. Of these, the most common is the camp site, but other indications of the presence of man are tipi rings, grinding stones, potsherds and factory sites. No less than 86 camp sites have been recorded. 'Scattered finds' number 67. An important but difficult source of material is the 'blow-out'—hollows in sandy soils and dunes caused by various agencies, natural and other, at the bottom of which archaeological and sometimes palaeontological material has collected. The region is of archaeological importance as the peripheral area of two cultures, the Plains culture and the Pueblo. This is reflected in the pottery, which has been examined, classified and discussed in detail. The distinctive character of the two types and their subdivisions are clearly shown. The lithic industry, however, in this area is of more importance than the ceramic. Two successive cultural phases are distinguished—the Basket-makers and the Pueblo. Of the former, the earliest phase is the 'Fumarole' culture, first discovered by Prof. Renaud and Mr. H. J. Cook. The 'fumaroles' or mounds then examined were found to cover rock shelters. The stone implements from the 'fumaroles' fall into three classes. Of these, the largest and most important, constituting the true 'fumarole' industry, is of quartzite, flaked by percussion and Mousterian in appearance. This 'Fumarole' culture is clearly anterior to the Basket-makers of the caves of Oklahoma and New Mexico, and may represent the nomads who are postulated as preceding the true Basket-makers.

Longevity of Monkeys

Two aged macaques are described by Prof. W. C. Osman Hill, both of which lived in Ceylon (*Spolia Zeylanica*, 20, Pt. 2, 255; 1937). One, a male toque macaque, *Macaca sinica*, was an experimental specimen of the Government Bacteriological Institute, Colombo, and had been used by Sir Aldo Castellani in his experiments on yaws which were published in 1907. It died on March 2, 1936, when it was known to be at least thirty years of age, and was probably thirty-five. Thus it exceeded the recorded age of any of its congeners, although the macaques are outstanding amongst monkeys on account of their length of life. The second specimen, a male Celebesian black macaque, *Macaca nigra*, was full-grown when purchased for the Trivandrum Zoo on June 15, 1907. It died in 1933 after twenty-six years of captivity, and must have been several years older. Flower states that the black ape seldom lives more than ten years in captivity; but gives two unusual examples of survival to fourteen and eighteen years—a limit considerably exceeded by the Trivandrum specimen.

Cheek Bones of Teleostomes

TAKING the sensory organs of the lateral line as a criterion, T. S. Westoll (*J. Anat.*, 71, Pt. 3; 1937) has endeavoured to clear up the confusion that exists in regard to certain of the cheek bones in teleostome fishes. In recent years, it has been shown that the bone in the most primitive tetrapods which is homologous with the mammalian squamosal is associated with the horizontal part of the jugal canal. This provides a starting-point from which to work backwards to the fish. It is found that in the Choanata generally, allowing for modifications resulting from the adoption of different feeding habits, a squamosal bone can be recognized to be lost perhaps only in certain late dipnoans. On the other hand, in all known Actinopterygii the canal has degenerated, and in consequence the squamosal bone has disappeared.

Decapod Crustacea of Japan

A ZOOGEOGRAPHICAL survey of the decapod Crustacea of the Seas of Okhotsk and Japan carried out by Z. I. Kobjakova shows that in both areas boreal forms predominate to the extent of up to seventy per cent of all the decapod species occurring in the seas (*Trav. Soc. Nat. Leningrad*, 65, 185; 1936). Next in order follow the arctic-boreal forms, followed by subtropical, and the poorest representation, particularly in the Japanese Sea, is of true arctic species. In this Sea there is no abyssal fauna, because of the shallowness of the straits, and the history of the Sea, which to the close of the Pliocene was an inland sea separated from the Pacific by a strip of land, is also that of a shallow basin the floor of which has sunk up to 4,000 metres only in recent times. The isolation from the Pacific accounts for the large number of endemic forms (21 per cent of *Macrura*), for the smaller number of Pacific forms, and partly for the influx in relatively large numbers (12.3 per cent) of typical southern sub-tropical and even tropical forms. The decapod fauna of the Japan Sea is richer (113 species) than that of the Sea of Okhotsk (81 species), but in the latter there is a true abyssal fauna derived from the Pacific Ocean; on the other hand, southern sub-tropical representatives are much fewer in number.

The Millipedes of India

No. 4 of vol. 11 of the *Memoirs of the Indian Museum* (1936) consists of a long memoir by Dr. C. Attems of Vienna on the Indian Diplopoda. Under the term "India" are included the whole of the Indian Peninsula, Ceylon, Burma, Indo-Chinese countries and China, excepting the Malay Peninsula. The author states that systematic and faunistic knowledge of the Indian Diplopoda is still very incomplete, and in fact we are only at the beginning of a faunistic explanation. In the present paper, 62 new species and 15 new genera are described. The most characteristic feature of this fauna is the great number of Sphaerotheridæ present, all the genera, excepting *Zephronia*, being endemic. Altogether, 290 species and subspecies of Diplopoda are known from the region dealt with and, excepting five, they are all endemic. Of the 92 Indian genera, 64, or nearly 70 per cent, are endemic. Only South India can be

regarded as at all properly explored with reference to these animals, while China, with only 21 known species of Diplopoda, is least explored of all. Dr. Attems's contribution is likely to remain as the basis for the study of the oriental Diplopoda for many years and is, consequently, a work of importance to all students and workers on that class of myriapods.

Classification in the Amaryllidaceæ

THE four genera of the Amaryllidaceæ, *Zephyranthes*, *Pyrolirion*, *Hippeastrum* and *Habranthus* have been encumbered with a confused taxonomy for the last fifty years. Their numerous species have made an ever-increasing contribution to garden beauty, and it is therefore most fortunate that Mr. J. R. Sealy has recently reduced their classification to order (*J. Roy. Hort. Soc.*, 62, Pt. 5; May 1937). Characters of the spathe, the andrœcium and the gynœceum, have confirmed Dean Herbert's original descriptions of the four genera in 1821, and discount more recent tendencies to include them in two groups. The outlook of the paper is that of a 'splitter', but the descriptions now given are exact and clearly defined. They should effect the exact correlation of the name of a plant species with its degree of beauty or utility, which is the necessary contribution of taxonomy to horticulture.

Rust-Resistant Antirrhinums

THE severe attack of antirrhinum plants by the rust-fungus *Puccinia antirrhini* in 1934, turned the attention of gardeners to possible methods of control. Mr. D. E. Green has shown that the fungus cannot reasonably be kept in check by fungicides, and he has recently described his trials with resistant plants (*J. Roy. Hort. Soc.*, 62, Pt. 5; May 1937). A number of strains of the antirrhinum of American origin have been found to possess varying capacities for resisting attack by the rust fungus. The best of them is 62 per cent resistant; but resistance is not as yet combined with horticultural excellence. The attainment of such a combination presents the urgent problem of the future.

Gold in Plant Ash

AN announcement was made some time ago (B. Němec, *Ber. deutsch. bot. Gesell.*, 53, 560; 1935) that traces of gold had been found in the ash of *Zea Mays* grains from plants grown in the Žitný Ostrov (the so-called Rye Island between the arms of the Danube in south Slovakia). Danube sand from this district is known to contain gold (about 0.1 gm. per ton) and plants are able to accumulate it. According to analyses, the metal concentrates in the seeds and fruit of flowering plants, whilst the whole plant of *Equisetum palustre* is found to accumulate gold to the extent of 610 gm. per ton of ash. It is found that the gold content is related to the silica content of the ash. Among the ashes examined the following percentages of gold were recorded:

<i>Zea Mays</i> (fruit)	0.00015-0.0002
<i>Urtica dioica</i> (plant)	0.00168
<i>Datura Stramonium</i> (fruit)	0.00202
<i>Helianthus annuus</i>	—
<i>Mentha arvensis</i>	0.030
<i>Clematis vitalba</i> (stem)	0.011
" (fruit)	0.06
<i>Salix caprea</i> (wood)	trace

Plants grown at other places where gold has been found were also found to contain recognizable amounts of the metal in the ash, but none was found in the

same species grown where gold was known to be absent. The metal was first detected by its reaction with dimethylamino-benzylidene thiocyanate, and later some of it was actually isolated by reduction and fusion into an ingot. Prof. Němec, in collaboration with Drs. J. Babička and I. Smoler, on February 27, read before the Czech Academy of Sciences a paper on the spectroscopic identification of gold in these plant ashes and gave further chemical evidence of the accumulation of the metal in the ashes of many plants growing in auriferous soils. The spectrograms are said to confirm the presence of gold in those plants in which the metal was detected by chemical means.

Geological Aspects of Deep Drilling Problems

THERE are three main differences between drilling a deep well and an ordinary well to a depth of only two or three thousand feet: in a deep well, the distance between points of development and application of mechanical power is increased, and temperatures encountered are higher and pressures greater. W. E. V. Abraham, in a paper presented to the Burma Branch of the Institution of Petroleum Technologists on May 4, considered the geological aspect of these three differences. The increased length of transmission shaft is on the whole an engineering problem, though geological forecasts as to depths at which particular horizons will be met are correspondingly less certain at greater depths; the strata drilled through are liable to be harder, tougher and more compact, and coring is a more difficult operation at depth. A point of interest to the geologist is that the depth/temperature gradient varies in different places depending on the nature of the strata encountered, that is, whether folded, synclinal or anticlinal. Sufficient data are not, however, available for the formulation of any theory of temperature/gradient variation. Other problems resultant upon increased temperature are concerned chiefly with cementation and mud control, and do not therefore come within the purview of the geologist. Increased pressure with depth, however, concerns the geologist vitally, and the problem is no simple one, since it has been proved that as a general rule fluid pressures do not increase in accordance with the corresponding hydrostatic head, but in some cases, after a certain depth has been reached, are more than twice the corresponding hydrostatic head. Several theories have been advanced to account for abnormal pressures encountered at depth, all of which are based on the assumption that free movement of the fluid is in some way prevented, with the result that high pressures are incapable of dissipation. The most probable cause of such abnormal pressures seems, on the evidence now available, to be the weight of overlying strata.

Hydrography of the River Severn

THE flow of the River Severn during the fifteen years 1921-1936 was the subject of a paper read before the Institution of Civil Engineers on April 20 by Prof. S. M. Dixon, Mr. G. Fitzgibbon and Dr. M. A. Hogan and now published. The Severn was selected for the purpose of flow investigation because it was the only large river free from artificial controls and river traffic within convenient distance from London. The portion of the Severn Valley dealt with lies above Bewdley and has an area of 1,632 sq. miles. The present course of the river seems to be the result of glacial action, and there are indications

that the pre-glacial valley ran northwards and is now covered by drift. It seems possible that a considerable quantity of water may be lost to the river by percolation along the direction of its old channel, particularly at low stages of flow. After discussing the selection of gauging stations, the methods of discharge-measurements and their accuracy, the paper (as reported in the *Journal of the Institution of Civil Engineers*, No. 7, 1936-37, June 1937) gives the results in graph form of 59 discharge measurements carried out during the years 1925-32 and one flood discharge in 1922. The largest discharge, 17,400 cusecs, was measured at the Elan Aqueduct bridge on December 11, 1929. Daily discharges for each of the fifteen years covered by the records have been plotted as hydrographs, of which five selected examples have been filed in the Institution library. Hydrographs of two floods (May 31-June 1, 1924 and February 16-22, 1928) are reproduced in the *Journal*. The difference between the average annual rainfall and the run-off (for the year commencing October 1) is 19.24 inches, or slightly more than half the rainfall. The largest loss, 23.80 inches, was in the year 1926-27, which had a high rainfall fairly evenly distributed throughout the year. The smallest loss was 13.63 inches in 1932-33, a year of low rainfall.

Borine Carbonyl

As is known, the simple hydride of boron, BH_3 (borine), has not been obtained, the simplest known hydride being diborane, B_2H_6 . A. B. Burg and H. I. Schlesinger (*J. Amer. Chem. Soc.*, 59, 780; 1937) find that a gaseous compound BH_3CO , which they call borine carbonyl, is obtained by the interaction of B_2H_6 with carbon monoxide in great excess and under pressure. The reaction reaches equilibrium rapidly at 100° ; at room temperature the reaction is slow enough to permit the isolation of the product: $B_2H_6 + 2CO \rightleftharpoons 2BH_3CO$. The formula was checked by the vapour density. The rate of decomposition is held to suggest the transitory existence of molecules of borine, BH_3 , but the isolation of the latter is not feasible. With ammonia, borine carbonyl forms a solid, stable at room temperature, having the empirical formula $BH_3CO(NH_3)_2$. Trimethylamine, on the other hand, rapidly and completely displaces carbon monoxide from the carbonyl at room temperature according to the equation $BH_3CO + (CH_3)_3N = (CH_3)_3NBH_3 + CO$, which is held to justify the conclusion that the reaction $BH_3CO \rightleftharpoons BH_3 + CO$ is far more rapid than the association of borine to form diborane. It is suggested that in borine carbonyl the borine and carbon monoxide are joined by a co-ordinate link consisting of electrons furnished by the carbon monoxide. The compound $(CH_3)_3NBH_3$ is remarkably stable and can be heated for some hours at 125° without showing any change in physical properties.

Response of the Ear to a Phase Reversal

C. S. HALLPIKE, H. Hartridge and A. F. Rawdon-Smith (*Proc. Phys. Soc.*, 49, 190) have studied the response of the mammalian ear to a sudden phase reversal in a sustained tone of sinusoidal wave-form. The tone was obtained from a photo-electric cell siren feeding an amplifier and loud-speaker, and an investigation with a piezo-electric microphone and cathode ray oscillograph showed that the phase reversal was present in the output from the loud-speaker. The effect of the phase reversal on a listener was that of a sudden temporary depression of the

sound intensity, sometimes accompanied by a tap or thud. The tone was then led to the ear of a decerebrate cat, and electrodes were applied to the auditory tract. The electrical disturbances were amplified and recorded. The record shows, instead of the phase-change, a temporary fall in response, which indicates that the aural elements in which these auditory tract potentials originate must be regarded as resonant structures. The electrical potentials obtained from electrodes on the cochlea were, however, similar to those from the microphone, and showed the phase change. It appears that the cochlear response originates in structures different from those responsible for the auditory tract response.

Separation of the Rare Earths

THE difficult problem of the separation of the rare earths has recently been attacked by a different method, employing the principle of distribution. Fischer, Dietz, and Jübermann (*Naturwiss.*, 25, 348; 1937) have found that it is possible to select liquids between which compounds of the rare earths will distribute themselves, and for pairs of which the distribution coefficients of the various rare earth elements are sufficiently different to enable a separation to be made. Thus, the halides of the rare earths will distribute themselves between water and organic liquids such as alcohols, ethers, and ketones, and the distribution coefficient is different for the compounds of different elements. By the addition of other substances to the system it is possible to alter the degree of separation. The difference in the distribution coefficient of the halides of two rare earth elements differing by unity in atomic number may be as great as 50 per cent, if suitable solvents and added substances are chosen. Automatic distribution fractionating apparatus may be employed, resulting in a much more rapid separation of the rare earths than can be accomplished by the tedious methods of fractional crystallization and precipitation.

A New Harmonic Analyser

THE problem of harmonic analysis arises in many connexions, and the labour of the arithmetical methods is such that several attempts to devise machines for the evaluation of Fourier coefficients have been made. An essential element of them all is, of course, some form of mechanical integrator. Henrici built several models, of which the last enables ten coefficients to be obtained in one operation, from a curve which is followed by a tracing point. A purely electrical instrument has been developed by Prof. Miles Walker and his collaborators which enables harmonics of a voltage or current wave to be separately determined; the integrator in this instrument is a watt-meter. A new instrument, designed by Mr. J. Harvey, of the Imperial College, made by Amsler, and of which an example has recently been added to the mathematical collection in the Science Museum, uses as the integrating device an ordinary planimeter wheel. The various harmonics are determined separately, each order by means of a separate, interchangeable pinion. Harvey's original model went only to the sixth order, but Messrs. Amsler, by added gearing, and without alteration of principle, have extended this number to ten (21 coefficients). With this instrument, results to an accuracy within 1 per cent can be obtained. The instrument can also be used to find areas and their first and second moments.

Development in International Geodesy*

By Dr. J. de Graaff Hunter, C.I.E., F.R.S.

THE increase in the scope of geodetic work accomplished in recent years and planned for the early future is remarkable. The fundamental problem of geodesy is the precise determination of the shape and dimensions of the earth, or what may be described otherwise either as the figure of the earth or the form of the geoid. When this is fully solved, benefits will accrue to geophysics as well as to geodesy.

In the nineteenth century, Colonel Clarke derived values of the elements of the terrestrial spheroid, first in 1866 and later in 1880. In 1866 Clarke used several meridian arcs, namely, Anglo-Gallic 39° – 60° N., Russian 45° – 70° N., Cape 34° – 29° S., Peruvian 3° – 0° S.; and both of Clarke's determinations are utilized in one or other of the great geodetic surveys. They may be considered as the best of those made simply from arcs of triangulation; but all such deductions are vitiated, more or less, by deviations of the vertical. In 1909 Hayford derived a new set of values from the triangulation of the United States, introducing the hypothesis of isostasy so as to avoid the effects of anomalous deviation of the vertical; and his figures were adopted by the International Union of Geodesy and Geophysics in 1924 at Madrid as defining the international spheroid.

Now we are entering a new era. The figure of the earth can be determined either from triangulation arcs or areas, or from gravity surveys; or from a combination of both. The greater the extent of the work of either kind, the higher is the precision which may be looked for in the results, which also become more detailed. In the first method, the weakness of determination has derived from the relatively small scope of the data. Thus Clarke's determination of 1866 was based on a few arcs of meridian of total amplitude less than 60° ; while Hayford's determination rested on an area which is less than two per cent of the earth's surface. Later determinations from the gravity field have also suffered from incompleteness of data. It is in the direction of greater fulness of data that a remarkable change is taking place; and this change is rendered possible and being brought into being by the Union of Geodesy.

There are now triangulation projects of a very comprehensive nature. The first resolution adopted by the Union of Geodesy and Geophysics at Edinburgh contemplates the junction of European and American triangulation across Asia and the Bering Straits; for which collaboration of the U.S.S.R. in Asia, the U.S.A. in Alaska, and Canada is essential. This will lead to a longitudinal arc of no less than 316° , mostly about latitude 52° , from which it deviates for the Asia-America junction. Of this work, 188° have already been finished. There remains to be done 4,800 km. from Irkutsk to Bering, 1,400 km. thence to the Alaska-Canada border and 1,100 km. in Canada.

Work in the U.S.S.R. is proceeding apace, and a great grid of triangulation is rapidly spreading over all that territory. Not only will the work extend to Bering, but, within five years, I am informed, it

will also reach the region of Tashkent and make strong connexion through an existent link with the system of triangulation of British India. A report (of Commission 18) was presented to the Union at Lisbon on the present state and future possibilities of extension towards Australia. Already continuous triangulation exists between India and Siam and thence with French triangulation in Indo-China; and only small gaps exist between the triangulations of Siam and Malaya (four triangles) and that of the Dutch East Indies (250 km.) which extends to Sumbawa in longitude 117° E. There are possibilities of extension thence to Australia.

Again, in Europe there is already connexion between the Arctic Ocean and Crete, where there is a sea-gap of 300 km. to the North African coast. A project for spanning this is envisaged in Resolution XIV. In this or some other way, continuity will be obtained with the meridian arc, Cape to Cairo. Of this latter, of amplitude 65° , more than 60 per cent is accomplished, the main gap of 18° being in the Anglo-Egyptian Sudan. The combined system will lead to a meridian arc of 105° .

Resolution I refers also to the junction of the two Americas. At present the North American system is continuous through Canada, U.S.A. and Mexico down to latitude 17° N.

It will be seen that these schemes will lead to the ultimate connexion of all the main land areas; and it is probable that a decade will see the linking of all the main land areas of the northern hemisphere. It is much to be desired that the African arc should also be completed by that time.

Now consider the gravity surveys. Here activity has been great during the last thirty years, and there are some thousands of reliable gravity stations in various parts of the world. In 1849 Stokes showed how the detailed form of the geoid could be expressed in terms of gravity values; but we are still not in a position to obtain a full solution by this means. This is because the distribution of stations is not complete. It is essential that all portions of the globe should have a certain minimum density of stations. Lack of this cannot be made up by much greater density in special regions. Efforts accordingly need to be co-ordinated. This is well recognized by the Association of Geodesy, and a commission to consider the matter of geoidal determination was formed at Edinburgh. Most of the work required for this end is to be done at sea, though there are also land areas, some difficult of access, which remain to be dealt with. Here again we may confidently expect the situation to develop in the course of a decade, so that it will be possible to make good use of Stokes's method. The best means of combining results of this kind with those based on triangulation requires study.

The position of geodesy will be entirely changed when all geodetic surveys are linked and their results expressible in correct relative terms; and this we now expect to be realized in a reasonably short time, owing to the co-ordinating activities of the Union of Geodesy.

*Report presented at the General Assembly of the International Council of Scientific Unions on April 26-May 3.

Reduction of Fading in Radio Communication

IT is now well known that part of the fading of signals experienced in radio communication is due to the variation of phase difference between the two or more sets of waves arriving at the receiver. These changes in phase difference arise in the course of transmission of the indirect waves through the ionosphere.

Two papers describing experiments demonstrating methods of reduction of this type of fading were presented early this year to the Wireless Section of the Institution of Electrical Engineers and are now available. The first paper, by Drs. A. L. Green and G. Builder, entitled "Control of Wireless Signal Variations", directs attention to the possibility, already known, of reducing variations in intensity of signals by combining the effects of two or more signals which have been transmitted on adjacent frequencies. After outlining the theory of the method, a description is given of experiments carried out between the University of Sydney and Liverpool, New South Wales, a distance of 25 km.

In this case, the fading was due to interference between the ground and ionospheric waves, and the curves accompanying the paper show that this fading could be considerably reduced by modulating the carrier wave at the transmitter, and integrating at the receiver the rectified current produced by the three sets of waves—carrier and two side-bands—so transmitted. The optimum effect is shown to be obtained when 100 per cent modulation is employed at a frequency dependent upon the path difference between the ground and ionospheric waves. A more complete control of the fading is obtained, however, if the carrier waves are suppressed, and only the two side-band waves are emitted at the transmitting station. Experiments carried out with this method have shown that fading, which under some conditions may be of the order of 85 per cent of the received signal amplitude, can be reduced to 5 per cent or less.

The second paper, entitled "Control of Phase Fading in Long-distance Radio Communication", by Drs. A. L. Green and O. O. Pulley, describes the extension of these experiments to greater distances. Measurements have been made at distances of 700 km. (Sydney-Melbourne) and 3,300 km. (Sydney-Perth) from the transmitter, and it was found that the phase fading was due to interference between two main ionospheric rays of comparable intensity. On account of the fact that the path of each of the ionospheric rays was subject to appreciable alteration during the day or night according as reflection takes place from the *E* or *F* region of the ionosphere, it was found desirable in these experiments to employ two modulation frequencies having a ratio of 3:1, the carrier wave being suppressed as previously described. The optimum control frequencies were found to be 200 and 600 cycles per second when the distance between transmitter and receiver was 700 km., whereas at 3,300 km. the best frequencies were 50 and 150 c.p.s.

The concluding portion of the first paper discusses briefly the possible application of these modulation methods of fading control to ionospheric research, to direction finding and to broadcast telegraphy and telephony. In connexion with telephony, it must be pointed out that the fading control does not apply directly to the audio-frequency components of the received waves, and a special additional modulation would be necessary to carry the intelligence. The possibility of the introduction of distortion would appear to make the application of the methods to high-fidelity broadcasting impracticable.

The investigations described in these papers formed part of the programme of the Australian Radio Research Board; in the absence of the authors, the papers were presented in London by Mr. J. A. Ratcliffe.

The Rehabilitation of British Agriculture

THE publication of the Minister of Agriculture's proposals for the assistance of agriculture in Great Britain gives greater pertinence to the three broadsheets on agriculture recently issued by Political and Economic Planning (P E P). These broadsheets have been prompted by the desire to stimulate better informed discussion and the elaboration of a constructive policy in accordance with the position of agriculture in the national economy.

The first broad sheet deals with the demands of agriculture and the difficulties encountered by the various approaches to a balanced view. The Free Trade, Protectionist, Defence, Consumer and Employment approach are all briefly reviewed, as are those based on nutrition, amenities, industry, land maintenance and ownership. The broadsheet suggests that the types of crop and livestock to be produced by British agriculture should be those which the country is naturally best fitted to produce in relation to other countries over a long period. Arrangements are

necessary for the control of imports and for marketing the home output to smooth out fluctuations of supply and prevent sudden changes in prices. Subsidies or reliefs to agriculture are not objectionable in principle, provided they are open and under effective Parliamentary review and directed to the constructive development of permanent assets, not the bolstering up or development of production which is permanently uneconomic or tends to a retrograde type of farming. Great importance is attached to making British agriculture once more a flourishing industry by the achievement of superior competitive efficiency in supplying certain parts of the market. A thorough overhaul of agricultural production and marketing and of land management is required to be applied to technique in order to realize the advantages of a modern industrial structure. A parallel overhaul of country social and utility services is also required to counteract the rival attractions of factory employment and town social services.

In the second broadsheet the problem is approached from the consumer's point of view, and the need for further information about consumption habits in different areas and at different income levels as a basis for market policy is emphasized, as well as the importance of making the necessary economic adjustments to enable British agriculture to take advantage, so far as possible, of demand changes in its favour and to minimize the repercussions of other changes in demand. Needs in distribution are summarized as assembling and placing at the disposal of the consumer a suitable supply of the products demanded, at convenient times, at the lowest possible cost and at prices he can afford, and carrying out a large range of ancillary services such as delivery and credit. The value of concentrating demand where possible and of steady contracts is stressed, as well as the opportunities of developing rival industries, and the importance of efficient organization in the farming units if the good will and support of the urban electorate are to be held. The Marketing Boards have as yet scarcely touched the major problems with which they are confronted of expanding the market for home produce, increasing the return to the farmer, and reducing the cost to the consumer through savings in transport and distribution, or gaining for the farmer a larger share in the profits of processing his output or in reducing the contribution to the profit derived by supplying him with fertilizers, feeding stuffs and seeds.

The third broadsheet, dealing with the farm and of agriculture, emphasizes that the industry has far

too many diverse elements and is affected by too many other activities at home and abroad for any one formula or panacea to offer a solution of its problems. Determined criticism of all one-sided approaches or ideas is indispensable. British agriculture is also regarded as having lost the close touch with the consumer demand which it had when the market was smaller and more static. The necessity for adapting agriculture as an industry in which the landowner and land agent, the farmer, agricultural engineer, the veterinary officer, marketing expert and other specialists can effectively work together is also stressed, as well as that of continuous local leadership. A stable rural basis for agriculture can no longer be assumed, and only an all-round policy of rural reconstruction can save British agriculture as a living and growing organism. Stable prosperity for farmers, it is suggested, can only be secured by types of farm and methods of farming designed to give the maximum net return each year over a long period. Agricultural subsidies and assistance should have for their objects urgent salvage or relief work of an essentially temporary nature for badly hit branches of the industry; permanent re-adjustment of the balance between town and country life, through subsidizing of rural roads, telephones and social services; and long-term development, such as improving farms and buildings, improving stock and eradicating disease, increasing the fertility of the soil, afforestation, land drainage, and information services. Particular stress is laid on the importance of increased expenditure on research.

Bantu Blood Groups

IN a comprehensive study of the blood groups of the Bantu of Southern Africa by Mr. Ronald Elsdon-Dew (*Pub. South African Inst. Med. Research*, 7, No. 39), a suggestion is made, based on this line of research, as to the early racial history of the African peoples.

Five thousand recruits for the Witwatersrand mines, grouped according to Bantu tribal origin, were submitted to the blood test. On this evidence it would appear that the Bantu are not homogeneous from a serological point of view; but as a whole they show a position close to the origin in the predominance of *O*, a position unoccupied except by such races as the American Indian, and indicating a more primitive distribution of the groups than is found in any other black race of which the figures are known. The known crosses of Caucasoid and Negro as exemplified in Algeria and Tunis occupy a position midway between the Caucasoid races and the origin. The Berber peoples show a small proportion of *B*, but they have a proportion of *A*, which gives them a type of distribution found in certain races separated early from the stock of mankind, such as the Australian aborigines. The Bush race shows a similar arrangement, while the Hottentot lies between the black races and the Egyptians.

The Southern Bantu are found to fall into three main groups, a primitive group, an intermediate group and a Caucasoid group. In the Caucasoid group fall the Mpondo and Xhosa. In comparison with other groups, this must have absorbed a con-

siderable proportion of Caucasoid blood. The Bushman-Hottentot complex could have had this effect, and this agrees with the fact that Mpondo and Xhosa show culturally and linguistically the results of Bushman-Hottentot contact to a greater extent than is shown by the other races. The intermediate group comprises Zulu, Shangaan, Tswana and Southern Sotho, corresponding roughly to the Nguni group. The primitive group comprises on one hand the Tehopi and Inyambane, about whose separate entity there is no doubt, and on the other hand the Swazi and Northern Sotho, whose position needs further investigation with reference to the Bantu as a whole, and the alleged primitive black race. If, as is usually held, the Bantu is derived from a Negro stock with Caucasoid (Hamitic) admixture, it is remarkable that serologically it should be more primitive than the Negroes of West Africa, a fact which suggests to the author a revision of early African racial history.

At some early date Africa was inhabited only by a black race, probably living near the west coast, and composed solely of the *O* group, as *A* and *B* had not appeared at the time it separated from the main stock. Africa was then invaded by a light-skinned small race bearing the factors *B* and *A*, which moved south, forming the Bushmen. A taller, light-skinned race with the factors *O* and *A* then arrived, but remained in the north, forming the Berber race. Then came a race with all the blood-groups which

spread all over Africa, pushing the Bushman south and giving rise to the Hottentots. The black race, still unaffected by *A* and *B*, moved south, following Bushmen and Hottentot and followed by other races with all the groups, who affected the black left behind in West Africa and the rearguard.

The Bantu are thus the result of the interactions between the Caucasoid and a primitive black race showing little or no *A* and *B*. Serologically they are more primitive than the Bushman, while if the Hottentot has had any effect it is only in recent times.

Excavations of the Egypt Exploration Society in Nubia, 1936-37

AN exhibition of archaeological finds by expeditions sent out by the Egypt Exploration Society at Tell el-Amarna and Sesebi on the Upper Nile in Nubia in the season 1936-37 opened in the rooms of the Palestine Exploration Fund, 2 Hinde Street, Manchester Square, London, W.1, on July 5, and will remain open until July 24.

The excavations in Nubia, which have been carried out under the direction in the field of Prof. A. M. Blackman, were undertaken in view of the approaching termination of the Society's operations at Tell el-Amarna, and in the expectation of obtaining a view of the culture of that period at an angle differing from that of the Amarna evidence. Sulb and Sesebi, sites covered by the concession granted to the Society by the Government of the Anglo-Egyptian Sudan, have been known since 1908 to be associated with Akhenaten, when the late J. H. Breasted identified Sesebi with the Nubian Gem-Aten, and recognized that the founder of the temple there had been Akhenaten, and not, as previously supposed, Sethos I, who had covered the inscriptions of the earlier king with plaster and inscribed on them his own name and a rededication of the temple.

Although the official name of the city was doubtless changed after the time of Akhenaten, the former name must have been retained among the people, as it was still known by that name seven centuries later, when the god of the place was recorded as "Amun of Gem-Aten".

The temple was founded about 1370 B.C., before Amenophis IV had changed his name to Akhenaten, as is shown by the foundation deposits. This change took place about the fourth year of his reign, or at Sesebi, owing to its remote situation, perhaps a little later. Scarabs of Tethmosis III and Tethmosis IV from the cemetery suggest that Sesebi was an Egyptian settlement of some importance long before the accession of Amenophis IV.

The fortified town of Sesebi is situated between the Second and Third Cataracts of the Nile, about one hundred and eighty miles south of Halfa. The fortress, which lies about two hundred metres distant from the river on the west bank, enclosed an area of about two hundred and seventy metres long by about two hundred metres broad. Its crude brick walls are about 4.60 m. thick, and in some places still stand to a height of 4-5 m. The width of the buttresses is approximately 3.15 m. and they stand out 2.65 m. from the walls. In each of the four walls is a well-constructed gateway.

Within the walls, the most striking feature is a group of three temples, before excavation thought to be one only, erected on a single and unusually solid substructure, and extending along the western side of a forecourt, once enclosed in massive walls. Four

sets of foundation deposits were found intact under the north-west and south-west corners of the substructure. They comprised among other relics two inscribed blue faience plaques and a large inscribed scarab of the same material, clearly showing that the foundation had taken place before the monarch's change of name. The full significance of this fact was brought out by reliefs on the walls of a subterranean crypt below the central temple, in which the king, sometimes with the queen, is represented seated in the company of various deities. The reliefs, therefore, belong to his polytheistic period, before he changed his religion to the monotheistic worship of the Aten. They are in the ordinary style of the Eighteenth Dynasty and not that of the Amarna period.

The crypt is in itself a remarkable discovery. It is the only known example of such a substructure at so early a date, preceding the well-known crypt of the Ptolemaic temple of Denderah by approximately thirteen hundred years.

What are conjectured to be portions of the sandstone façade of the temple, showing some highly finished reliefs, were found. Of these one shows the head of the goddess Hathor, while on another are the heads of two negro prisoners, possibly part of a much larger war relief, to which belonged a representation of the king slaying captives, not brought to England. The style of this block, with the strongly marked features and masterly line, closely resembles that of the magnificent scenes in the tomb of Horemheb. It is probably to be assigned to the end of the Eighteenth Dynasty. Mention may also be made here of a remarkable head of a granite statue of a king, or possibly of Queen Hatshepsut.

Outside the temple area an important find was a stone structure situated close to the north-east corner, which had undergone at least one reconstruction. In its original form it had been a small colonnaded open court on a stone platform about 11.70 m. square and two metres high. This had been the work of Akhenaten, and possibly was a small sun temple, a view supported by the unusual feature that it was approached by a ramp or stairway on the western side, which would enable the officiating priest to greet the rising sun on entering the temple at dawn.

Immediately south of the temple were found three rows of magazines, and south of these again the south-western portion of the residential area. In the magazines a doorjamb inscribed to a vizir of the reign of Amenophis II supports the earlier dating of the settlement.

Although the area of the town examined had been much disturbed, it produced a quantity of interesting material. It has been possible to make out the symmetrical rectangular planning of the streets.

To the west of the town lies the New Kingdom cemetery, which seems to have been subjected to considerable deprecation. Tombs had been plundered, re-used and plundered again. Nevertheless, it supplied a fine collection of scarabs and much pottery, as well as other objects. Three groups included bronze mirrors laid on the chest, one a very fine specimen, and with another was a bronze bowl. A remarkable

example of fine work is a green felspar amulet in the form of a baboon with the moon-disk on its head, and probably from the same string was a *millefiore* bead in the original gold mount. In one tomb the face painted on the cartonnage has survived. One exhibit of no little interest, though late in date, is a human pelvis still wrapped in its leather loin-cloth.

Association of Technical Institutions

SUMMER MEETING AT BLACKPOOL

THE summer meeting of the Association of Technical Institutions was held at Blackpool on June 24-26.

Two reports having a direct bearing on policy were presented and discussed. The first was the report on policy in technical education, prepared by a joint committee of the Association of Technical Institutions, the Association of Principals of Technical Institutions, the Association of Teachers in Technical Institutions and the National Society of Art Masters. First published in 1932, this report has been twice revised, in 1934-35 and in the form presented to the recent Conference. Its field is wide and includes descriptions of the present system, courses of instruction, regional co-ordination of technical education, examinations, scholarships, libraries, staffing, technical education in small towns, buildings and equipment and social activities. The second report dealt with Education for Citizenship in Technical Institutions and is dealt with in the leading article in this issue of NATURE.

Of special and immediate interest was a paper on education in industrial management prepared by Mr. E. S. Byng, vice-chairman of Standard Telephones and Cables, Ltd., and Mr. G. A. Robinson, principal of the South-East London Technical Institute. This branch of education has grown considerably of late years both in Great Britain and in the United States, and its importance cannot be underestimated. As one expert has put it: "Such training was not to be a substitute for experience. . . . The growing complexity of industrial organizations, the evolution of new techniques, the application of science to industry, the growing size of business units and such items as industrial, economic and technological factors combine to make successful management far more complicated and difficult than it was in the past. Experience plus training are recognized in all professions civil and military. Is management the only profession where training is unnecessary?" The social significance of the subject was well expressed by the authors of the paper when they said: "One of the greatest services which education in regard to management could render would be to imbue the general body of workers with a sound elementary knowledge of the principles affecting the conditions, conduct and direction of the undertaking which they serve. In a democracy, an understanding of the principles by the workers would assist management, whereas in a dictatorship the conditions may be different."

The authors further brought out the vast increase

in the number of persons who are now concerned in management. Modern manufacturing methods actually require a much larger proportion of administrative workers than was necessary under earlier conditions. In a typical engineering organization with approximately 10,000 employees, those engaged in one phase or other of management may represent as much as twenty-five per cent of the total staff. It is not to be wondered at, therefore, that many of those in control of industry feel the need for a constant supply of young men not only proficient in the technology of departmental functions, but also trained in the principles of administration. Appendices to the paper included a list of schools where instruction in management is given, and syllabuses of "Fundamentals of Industrial Administration", "Workshop Organization and Management", and "Works Supervisory Course".

Dr. E. Benson, headmaster of the Blackpool Grammar School, read a paper on "The Grammar Schools and Technical Education". He admitted that he approached the subject from the point of view of the grammar schools. During the discussion, it was made clear that technical educationists, while differing sometimes with the educational views put forward by those connected with grammar schools, have no quarrel with grammar schools and their work as such. At the same time, they spoke their minds with some freedom when they thought the grammar schools were claiming a kind of monopoly in educational powers. Dr. Benson quoted Sir Josiah Stamp's saying that education to-day might be considered to have three main objects. It trains individuals to get a living, to live a life and to mould a world—in other words, it is education for work, leisure and responsibility. Dr. Benson's claim that the grammar school "does its best to give this complete education" may be true; but there are not lacking many who would challenge it. Neither are there lacking many who would demand to hear much more argument before they could be convinced that none of the types of post-primary schools "has succeeded so far in sharing with the grammar schools the most important of the vital qualities which the grammar schools possess. . . ." The same people would probably think that Dr. Benson had only appreciated a part of the work when to that remark he added ". . . except that junior technical schools, especially in conjunction with senior technical institutions, have, although they are comparatively few in number, established high standards for example in accuracy and craftsmanship".

University Events

BIRMINGHAM.—At the annual degree congregation held on July 3, the Chancellor (Viscount Cecil of Chelwood) conferred the honorary degree of LL.D. on the following: The Right Hon. Lord Austin, Sir Harry Gilbert Barling, Mr. Edward Cadbury, The Right Hon. Sir Wilfrid Arthur Greene, and Sir Percival Perry. The honorary degree of D.Sc. was conferred on Mr. C. C. Paterson.

The ordinary degree of D.Sc. was conferred on D. A. Howes for a treatise on "The Principles of Motor Fuel Preparation" (in collaboration with Prof. A. W. Nash) and for a paper on "The Use of Synthetic Methanol as a Motor Fuel" and other papers on allied subjects (*J. Inst. Pet. Tech., J. Soc. Chem. Ind.* and elsewhere).

The degree of M.D. (*ex officio*) was conferred on Prof. H. P. Newsholme.

CAMBRIDGE.—Dr. A. D. Thackeray, of King's College, has been appointed assistant director of the Solar Physics Observatory for five years from July 1.

An appointment to a research studentship at Christ's College will be made at the end of July 1938. Candidates must be men who will have graduated before October 1, 1938, at some University other than Cambridge, and they must be not more than twenty-six years of age on that date. Preference will be given to those who have already devoted at least a year to research. Further information can be obtained from the Master, Christ's College, Cambridge. Detailed information about the admission of research students to the University will be found in the "Student's Handbook to the University of Cambridge", published annually by the Cambridge University Press. It may be estimated that the total annual expenses, including vacations, of a research student at Cambridge, is about £350 a year.

Sir David Chadwick has been elected to an honorary fellowship at Sidney Sussex College, not at Christ's College, as stated in *NATURE* of July 3, p. 38.

EDINBURGH.—At a graduation ceremonial on July 2 the honorary degree of LL.D. was conferred on the following, among others: Prof. L. H. Baekeland, hon. professor of chemical engineering, Columbia University, New York; Sir William Bragg; Dr. N. M. Butler, president of Columbia University, New York; Sir Herbert Grierson, rector of the University; Dr. Alexander Morgan.

The Principal, Sir Thomas Holland, referred to the sense of loss felt by the University on the death of its Chancellor, Sir James Barrie, who in a letter written only three days before he was taken seriously ill, had expressed his intention of presiding at that graduation. It was at a similar ceremonial, as the Principal recalled, that Barrie was 'capped' fifty-five years ago.

ST. ANDREWS.—It has been decided to confer the honorary degree of LL.D. on the following: Prof. G. F. Stout, professor of logic and metaphysics in the University from 1903 until 1936, and Dr. W. T. Calman, president of the Linnean Society, lately keeper of the Zoology Department, British Museum (Natural History).

Science News a Century Ago

Mushet's Discovery of Blackband Ironstone

DAVID MUSHET (1772-1847) was among the foremost metallurgists of his day, and besides contributing articles on iron manufacturing to the "Encyclopædia Britannica" and "Rees' Cyclopædia", he contributed some thirty papers to the *Philosophical Transactions*. On July 12, 1837, he wrote a letter from Coleford, Gloucestershire, to the editor of the *Scotsman*, in which there had been a communication on the iron trade of Scotland and the blackband ironstone. In this letter he said: "As this ironstone has now become an object of considerable national importance, perhaps you will allow me room to allude more particularly to the circumstances of its discovery. Thirty-six years ago this summer, in attempting to cross the river Calder on foot, in the Old Monkland Parishes, I obtained nearly a dry footing upon what appeared to be a continuous black pavement, from the upper edge of which I struck off a piece of substance resembling coal, which upon closer examination, was found interlaminated with yolks of brownish matter, about three-eighths of an inch in thickness. These when separated from the carboniferous schist, proved to be good ironstone, but so small in quantity, that the average of the mass did not exceed 13 per cent. Next day I returned to the black pavement, better prepared to ascertain its extent and thickness. On removing a portion of the entire bed, I found it to be fourteen inches in thickness, viz., three and a half of coaly schist with the before-mentioned yolks, and ten and a half of more compact and solid matter. . . . In a short time from making this discovery I had ascertained the existence of the Blackband in 2,000 acres of land, including the Airdrie estate (for right of working in which, to a limited extent, £12,000 a year is now to be given) and determined it to be a regular member of the coal formation. . . ."

Advancement of Medical Science

AN editorial article in the *British Annals of Medicine* of July 14, 1837, contains the following passage: "Reform in institutions is advancement in the sciences, and the latter is not the least deserving attention at the present time. Our practice is based on physiological indications, and much of the current physiology is false; in this country it is not yet on a line with the actual state of the science. We have too much metaphysical reasoning about functions and about diseases, too little systematic observation. . . . Could not the Association encourage the invention of some systematic form by which the observations of a great number of members may be collected and compared? If we are to believe a contemporary, Dr. Haviland rebuked the College of Physicians in very elegant Latinity—not for their scientific apathy, not even for forgetting their mathematics, or for not applying them to vital phenomena, but for selecting fellows unversed in Latin and Greek. Better things may have been expected from Dr. Haviland, but it is as difficult for an Oxford and Cambridge professor as for an Irvingite to raise his thoughts above the 'tongues'. The University of London will, we understand, reduce languages to their subordinate place as instruments in the general scheme of education."

Thomas Graham at University College, London

ON July 15, 1837, the *Mechanics' Magazine* said: "The Chemical Chair of the London University College, vacant through the lamented demise of Professor Turner, has been conferred on Mr. Graham, the Andersonian Professor of Chemistry at Glasgow. A better selection could scarcely have been made. Mr. Graham was first made favourably known to chemical philosophers by his discovery of the laws of gaseous diffusion. He established by well-devised experiments, the conformity of gases flowing through minute orifices, to the universal physical law that determines the issuing velocities of non-elastic fluids. During the last five years he has been diligently engaged in elaborate inquiries into the constitution of salts, with special reference to the functions of their watery element, and has already published some results that are considered by good judges to affect materially the higher doctrines of chemical philosophy."

Medical Schools in Russia

THE issue of the *London Medical Gazette* of July 15, 1837, contains the following account of the contemporary medical schools in Russia: "There are three principal universities in Russia proper, those of Moscow, Harkoff and St. Petersburg; and each of these universities has a large school of medicine. Those of Moscow and St. Petersburg are the most considerable, but there is still a good school at Harkoff, situated in the southern part of the empire, and destined for the convenience of the nations of the conquered provinces on the Asiatic borders. Each university which has a faculty of medicine has also an institute of medicine of the same kind; the students who attend the latter are educated at the expense of the Government, and are subsequently obliged to serve six years, at least, in the civil or military service. Although the first rudiments of a medical school at St. Petersburg are to be found in the establishment of the naval school by Peter the Great in the year 1715, yet the merit of organizing a medical faculty is due to Catherine the Second. In 1764 the Empress founded a medical college which with but few alterations from its first instalment is still recognized in the Medico-Chirurgical Academy of St. Petersburg. To the jurisdiction of this institution were subjected then, as at present, all the medical institutes and all medical practitioners, with the exception of court physicians, in the Empire."

Ploughing by Steam

THE issue of the *Gentleman's Magazine* of July 1837 contains the following announcement: "A very successful and interesting exhibition of ploughing by steam, invented by Mr. Parkes, took place at Red Moss, near Horwich, Lancashire. The engine is not locomotive, but remains stationary while the plough is at work. The plough is set in motion by means of two long, flexible belts of iron, revolving round two wheels attached to the engine, and round another wheel in a frame firmly fixed on the moss, at such a distance from the engine as may be proposed to make the furrow. The ends of these belts are fixed to the two ends of the plough, and pull it to and fro, for it does not turn in working, but cuts a furrow both when it recedes from and returns to the engine. This operation is most satisfactory, the plough turning a furrow eighteen inches broad, nine inches thick, and more than 300 yards long in less than four minutes.

Societies and Academies

Dublin

Royal Irish Academy, April 12.

P. G. GORMLEY: The zeros of Legendre functions. The number of zeros of the function $Q_n^m(z)$, n and m being real, is determined by considering the change in phase due to a complete circuit round the plane, the number which are situated on each axis being given. Those zeros of the function $P_n^m(z)$ which lie to the right of the imaginary axis are considered.

A. C. FORBES: Some climatic theories in connexion with tree remains in and under peat. The stump layers in lowland bogs, which various observers from Geikie onwards have attributed to secular changes in rainfall, merely represent vegetative features in the development of marsh peat. They are the remains of trees which originated, matured and died on a saturated or water-logged substratum induced by topographic features, and neither normal nor periodic fluctuations in rainfall could have affected them to any material extent as is shown by their characteristic root development. The stump remains under mountain (soligenous) peat represent the final generations of pine and birch which gradually disappeared at high elevations, resulting in forest being replaced by peat, which, in its turn, is disappearing above 2,000 feet or so. These changes must be correlated with lower temperatures during the growing season, and the general tendency during the last 2,000 or 3,000 years in the British Isles has apparently been in the direction of cooler and moister summers and milder winters, and the altitudinal tree limit during that period has been lowered to about 1,000 feet. The rainfall and temperature conditions for peat formation are still in operation at the lower levels, and these do not differ in any important respect from those necessary for forest growth.

Paris

Academy of Sciences, May 19 (*C.R.*, 204, 1449-1516)

JULES DRACH: The logical integration of linear differential equations.

NICOLAS KRYLOFF and NICOLAS BOGOLIUBOFF: The ergodic properties of series of probabilities *en chaîne*.

SZOLEM MANDELBJROT: A general theorem furnishing the argument of singular points situated on the circle of convergence of a Taylor's series.

JACQUES HADAMARD: Remarks on the preceding note.

RAOUL GOUDEY: Measurements of the intensity of gravity in France during the year 1936. Results for the values of g at fifty stations in France carried out with the Holweck-Lejay instrument.

VICTOR VOLKOVISKI: Vortices in bands in liquids.

ANDRÉ GUILBERT: The elementary expression of the energy affecting a magnetic particle of very small dimensions in a magnetizing field.

RAYMOND HOCART and MAURICE FALLOT: The identification of various phases by magnetic study and by the X-rays in alloys of iron and palladium. The magnetic study showed two phases the approximate composition of which are $FePd$ and $FePd_3$, and these were confirmed by the X-rays. The phases only appear after prolonged annealing.

BORIS VODAR: The absorption spectrum of nitric oxide (NO) in the liquid state.

Mlle. MILKA RADOITCHITCH: The influence of the solvent on the absorption spectra of neodymium acetylacetonate. Summary of results obtained with

- 39 organic solvents. Neither the dielectric constant nor the electric moment afford an explanation of the results. These intervene, but there are other factors which complicate the comparisons.
- MME. NIUTA WINTER-KLEIN: The relation which exists between the temperature of transformation and the variation of the (refractive) index for several kinds of glass.
- W. BRONIEWSKI and I. ST. GLOTZ: The physical and mechanical properties of pure iron as a function of the cold hardening.
- LOUIS HACKSPILL and ANDRÉ BOROCO: Compounds of the isotope 2 of hydrogen with the alkali metals (alkaline deuterides). The alkaline deuterides can be obtained by synthesis under the same conditions as the hydrides, their formulæ are analogous with the latter, and their appearance is the same.
- MARTIN BATEGAY and PIERRE BOEHLER: The anthrylisothiocyanates, anthrothiazols and mercaptoanthrothiazols.
- MARCEL FRÈREJACQUE: Acetylglucosides of amines and rotary power.
- RAYMOND PAUL and HENRI NORMANT: The action of furfuryl bromide on sodium phenate, o-furfurylphenol and furfuryloxybenzene.
- R. TRUHAUT: Study of the compounds of glycol and of alanine with mercuric oxide.
- LOUIS LONGCHAMBON: The pyrogenation of coal. Studies of the coefficient of expansion of coal at temperatures below the coking temperature.
- ANDRÉ DEMAY: The age of the metamorphism in the Central Massif.
- MAURICE BREISTROFFER: The fossiliferous levels of the Albian in the Vocontian abyss (Drôme, Hautes-Alpes and Basse-Alpes).
- CHARLES BOIS: The determination of the focal depth of very distant earthquakes.
- A. DEMOLON and E. BASTISSE: Observations in lysimetric boxes on the mobilization of the nitrogen and mineral reserves of the soil.
- STÉPHANE HÉNIN: Asymmetry and the orientation of clay particles.
- WILLIAM HENRI SCHOPFER and ALBERT JUNG: The action of the products of disintegration of aneurine on *Phycomyces*. The second growth-factor of the *Mucorinæ*.
- MME. ANDRÉE DRILHON: Study of the mineral exchanges in the homeiosmotic fishes.
- Mlle. M. HAMON: The mechanisms producing dehiscence of the spermatophores of *Eupagurus Brideauxi*.
- BASILE LUYET: The mechanism of cellular death produced by high pressures: the cytological modifications accompanying death in yeast.
- ROBERT PAULAIS: Copper, zinc and cobalt in the organs of Lamellibranch molluscs.
- ANDRÉ LWOFF and MME. MARGUERITE LWOFF: The function of hæmin, growth factor for *Hemiphilus influenzae*.
- LÉON BINET, GEORGES WELLER and CHARLES JAUMES: The antitoxic power of glutathion. Researches on cobra poison.
- Moscow
- Academy of Sciences (C.R., 14, No. 6; 1937).
- S. BERNSTEIN: The Cotes and the Tchebycheff formulæ of quadrature.
- ERVIN FELDHEIM: Mode of convergence in the interpolation of Lagrange.
- N. A. Slioskin: Oscillations in rotation of a sphere filled by a viscous liquid.
- V. V. ČELINEV: Structure of organo-magnesium complexes.
- N. A. ORLOV and A. T. SHALYGIN: Preparation of carbohydrates by auto-oxidation of some hydrocarbons.
- A. G. BERGMAN: Discovery of boron in Central Asia.
- S. A. BOROVIK: (1) Finds of tin in micas. (2) Spectroscopic determination of rare earth elements in some minerals found in the U.S.S.R.
- V. SMIRNOV and N. AIDINJAN: Determination of ferrous oxide in rocks and minerals.
- A. P. VINOGRADOV: Manganese in insects (*Formicidæ*). The problem of the chemical composition of organisms as a specific character.
- A. P. VINOGRADOV, V. V. DANILOVA and L. S. SELIVANOV: Fluorine content of the rivers of the Union (in connexion with the occurrence of mottled enamel tooth disease).
- I. A. SMORODINCEV and A. M. FELDT: Critical survey of methods of the separation of thyroglobulin.
- I. A. SMORODINCEV and S. P. BYSTROV: Influence of freezing on the swelling of meat.
- E. V. PAVLOVSKIJ: New data on the stratigraphy of Cambrian deposits in the Lake Baikal region.
- ŠAFRANOVSKIJ: Distribution of angular values in crystals.
- M. S. LOICJANSKAJA: The first stages of the decomposition of cellulose by *Spirochaeta cytophaga*.
- D. NOVOGRUDSKIJ, E. BEREZOVA, M. NACHIMOVSKAJA and M. PERVIAKOVA: Influence of bacterization of flax seed on the susceptibility of seedlings to infection with parasitic fungi.
- E. D. BUSLOVA: A contribution to a method of cultivating embryos of higher plants, deprived of the nutritive reserves of the seed.
- K. T. SUCHORUKOV and K. E. OVČAROV: The nature of immunity to rust.
- A. A. ISAKOVA and A. SMIRNOVA: Influence of various microbe complexes of bacteriorhizas on the development of higher plants.
- A. G. TOMILIN: Observations on Far Eastern whales.
- A. A. VOITKEVIČ: The anterior lobes of the hypophysis and growth and differentiation phenomena in amphibians (1) and (2).
- G. STREICH and E. SVETOZAROV: The morphogenetic role of the thyroid in the process of feather formation.
- Moscow
- Academy of Sciences (C.R., 14, No. 7; 1937).
- N. ACHYESER and B. LEWITAN: Application of the inequality of H. Bohr and I. Favard.
- V. FABRIKANT, F. BUTAJEVA and I. CIRG: The absolute concentration of excited atoms in a low-pressure mercury discharge.
- M. VEINGEROV: A radiometer of low inertia based on the principle of gas thermometer.
- L. KIBEL: Mathematical theory of front shifting in the atmosphere.
- S. J. TURLYGIN: Biological effect of centimetre waves.
- N. N. MALOV: The law of nervous excitation by alternating currents.
- I. LEONTJEV and K. MARKOVA: The curve of the 'racemization' of proteins from the muscles of certain invertebrates.

J. V. RAKITIN : Absorber for acetic aldehyde determination.

G. D. PRATASENJA : Production of polyploid plants after regeneration (2). Autotetraploid of *Nicotiana glauca*.

D. KOSTOFF : Studies on polyploid plants (16). *Nicotiana rustica* and *Nicotiana tabacum* amphidiploid.

E. S. SAPRYGINA : Vernalization of wheat hybrids of the first generation.

A. A. ISAKOVA : The true influence of bacteriorhizal micro-organisms on the germination of seeds (2).

A. V. IVANOV : A new ectoparasitic mollusc of the genus *Megadenus* Rosen.

T. A. BEDNJKOVA : Induction of the infundibulum by the anterior end of the chorda.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 189-250, April).

C. E. NURNBERGER : Ionization theory and radiobiological phenomena. Assuming that hydrogen is the chief absorber in biological materials of neutrons, the ejected protons are the cause of the major part of the ionization. The concentration of ions produced by protons, and also by α -particles, is more than a hundred times that produced by electrons, and irradiation of aqueous solutions of tyrosine with X-rays (Stenstrom and Lohmann) and with α -particles gives results supporting the view that the chemical changes produced depend on ionic concentration. The relation of this work to recent investigations of the 'selective effect' of neutron irradiation of tissues is discussed.

A. A. BLESS : Effects of the length of X-ray waves on seeds. For moderate dosage, two minutes' exposure gives optimum growth at one stage, while at a later stage, optimum growth is produced by a different exposure. Over the range 0.6-0.12 A., the effects seem to be independent of wave-length.

M. MUSKAT and E. HUTCHISSON : Symmetry of the transmission coefficients for the passage of particles through potential barriers. A general wave-mechanical proof.

P. W. BRIDGMAN : Polymorphic transitions of inorganic compounds to 50,000 kgm./cm.². Thirty-five, out of eighty-five, such substances show polymorphism, and the transition parameters (pressure, temperature, change of volume and latent heat) have been determined. The temperature range of the experiments was -79° C. to 200° C. The ice-type of transition (stable phase at higher temperature has the smaller volume) tends to become more common at high pressures. Latent heat shows no statistical trend with increasing pressure, but the energy change tends to increase proportionally with pressure, leading to the view that the atoms increase in size on passing to the high-pressure form. This suggests that an important fraction of the electrons of the high-pressure form are in an essentially different state from that in the free atoms.

G. H. PARKER : Colour changes due to erythrophores in the squirrel fish, *Holocentrus*. This fish changes from red to white in about 6 sec., and from white back to red in about 19 sec., on transfer from a black-walled illuminated vessel to a white-walled one or the reverse, due to expansion or contraction of red pigment in the erythrophores. Cutting through

nerves supplying the skin suggests the existence of dispersing and concentrating nerves; the latter, at least, are activated by a neurohumor soluble in lipoids.

F. B. SUMNER and P. DOUDOROFF : Some quantitative relations between visual stimuli and the production or destruction of melanin in fishes. Colour adjustment of fishes and amphibians to background depends on (1) dispersion or concentration of pigment in chromatophores (rapid), (2) changes in amount of pigment (slow). This paper deals with the latter. Fish were placed in two series of four tanks painted white, grey, dark grey and black respectively, one set being illuminated by two 200-watt lamps, the other by two 10-watt lamps. After 87 days, the melanin contents of fish from each tank was estimated photometrically.

R. GOLDSCHMIDT : A remarkable parallelism. In investigating the mutant 'vestigial' in *Drosophila* and its series of multiple alleles, it has been found possible to arrange them in a series with increasing degeneration of wing tissue. It is thought that the genes control the production of a growth-promoting substance, and that the different alleles produce an insufficiency which, below a certain threshold, causes degeneration. Representing the data graphically, the curves produced are identical with those of Krueger on the relationship of bacteria and phage, indicating that the kinetics of the two processes are the same.

E. W. SINNOTT : The relation of gene to character in quantitative inheritance. If the distribution as to a given quantitative trait in an F_2 population is symmetrical, it is concluded that each gene makes a constant absolute contribution and that the contributions are cumulative; if, on the other hand, the distribution is skewed, this is considered as evidence that the genes are interacting and producing a geometric or multiplicative effect. Experimental work on fruit size in *Cucurbita Pepo* favours the latter view.

S. HECHT : The instantaneous visual threshold after light adaptation. In 1918, J. Blanchard published data on these thresholds. The eye was adapted to a given intensity by looking at a large illuminated area. At a given moment the adapting light was cut off and the minimum illumination required to make visible a central area at the same moment was determined. These data can be explained on the duplicity theory (cones functioning at high intensity and rods at low intensity), and numerical details of the data conform to the mathematical predictions of a photoreceptor process consisting of (a) a primary photochemical reaction whereby a photosensitive material is converted into active products, (b) a primary dark reaction maintaining the supply of photosensitive material, (c) a secondary dark reaction in which products of (a) undergo a change providing an impulse to the attached nerve.

G. A. MILLER : The groups of order p^m which have $m - 1$ independent generators.

R. BRAUER and C. NESBITT : Regular representations of algebras.

N. JACOBSON : Simple Lie algebras of type A.

D. V. WIDDER : The iterated Stieltjes transform.

K. MENGER : Metric methods in calculus of variations.

S. PASTERNAK : The mean value of r^s for Keplerian systems : a correction.

Forthcoming Events

INFORMAL CONFERENCE ON "CONDUCTION OF ELECTRICITY IN SOLIDS", July 13-16.—Arranged by the Physical Society and the University of Bristol, to be held in the H. H. Wills Physical Laboratory, University of Bristol.

Tuesday, July 13

SOCIETY FOR THE STUDY OF INEBRIETY, at 4—(at 11 Chandos Street, Cavendish Square, W.1).—Mrs. Lillias M. Blackett Jeffries: "Marriage in Relation to Alcohol and Drug Addiction".

Wednesday, July 14

BRITISH ACADEMY, at 5.—Dr. Paul Schrecker: "Leibniz: with Special Reference to his Views on International Relations".

Appointments Vacant

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

ENGINEER at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (quote J. 37/10) (July 12).

LECTURER IN MINING in the Chesterfield Technical College—The Clerk to the Governors (July 14).

LECTURER IN ELECTRICAL ENGINEERING in Armstrong College, Newcastle-upon-Tyne—The Registrar (July 15).

LECTURER IN MECHANICAL ENGINEERING in the Northampton Polytechnic, St. John Street, E.C.1—The Principal (July 16).

RESEARCH CHEMIST with the Bone Research Association—Prof. W. A. Bone, Imperial College, South Kensington, S.W.7 (July 16).

LECTURER IN VETERINARY PHARMACOLOGY, LECTURER IN VETERINARY PARASITOLOGY, and LECTURER IN ANATOMY OF DOMESTICATED ANIMALS in the Department of Agriculture, I.F.S.—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 16).

LECTURER IN MATHEMATICS and LECTURER IN CHEMISTRY in the Kingston Technical College—The Principal (July 17).

ASSISTANTS (grade III) in the Signals Experimental Establishment, Woolwich, S.E.18—The Superintendent (July 19).

LECTURER IN CHEMISTRY in the University of Birmingham—The Secretary (July 21).

ASSISTANT CHEMIST in the Biochemistry Section of East Malling Research Station, Kent—The Secretary (June 23).

DIRECTOR of the All-India Institute of Hygiene and Public Health, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 24).

PRINCIPAL of the South-West Technical College, Walthamstow—The Director of Education, County Offices, Chelmsford (July 24).

LECTURER IN HORTICULTURE and NATURE STUDY in the Stranmillis Training College, Belfast—The Principal (July 29).

GEOLOGISTS in the Geological Survey of Great Britain and Museum of Practical Geology, Exhibition Road, South Kensington, S.W.7—The Director (July 31).

STRUCTURAL ENGINEERING DRAUGHTSMEN in H.M. Office of Works—The Chief Architect (Ref. G. W. Strent), Room 131A, iv. Flr., H.M. Office of Works, Storey's Gate, S.W.1.

LECTURER IN CHEMISTRY in the Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton 1.

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT in the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon.

Official Publications Received

Great Britain and Ireland

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1936. Pp. 78. (Shinfield: National Institute for Research in Dairying.) [26]

Statistical Year Book 1937 of the International Tin Research and Development Council. Pp. 206. (London: International Tin Research and Development Council.) 6s. [36]

P E P (Political and Economic Planning). Report on International Trade: a Survey of Problems affecting the Expansion of International Trade, with Proposals for the Development of British Commercial Policy and Export Mechanism. Pp. vii+302. (London: P E P.) Paper boards, 8s. 6d. net; cloth, 12s. 6d. net. [36]

Joint Board of Research for Mental Disease: City and University of Birmingham. Annual Report, 1936-37. Pp. 15. (Birmingham: University of Birmingham.) [36]

Other Countries

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 16, 1934. iv. Meteorologiska iakttagelser i Sverige, Band 76. Pp. x+107. 7.00 kr. vii. Meteorologiska iakttagelser i Riksgården. Pp. ii+40. 4.00 kr. Meddelanden, Band 6, No. 5: Meteorological Observations at Mount Nordenskiöld, Spitzbergen, during the International Polar Year 1932-1933. By Hilding Olsson. Pp. vii+83. 3.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [36]

Université de Paris: Faculté des Sciences. Institut de Physique du Globe: L'Observatoire géophysique de Chambon-la-Forêt. Pp. 19. (Paris: Université de Paris.) [36]

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 339: The Digestibility of Rations by Cattle and Sheep. By Ernest B. Forbes, John W. Bratzler, Alex Black and Winfred W. Braman. Pp. 30. (State College, Pa.: Pennsylvania State College.) [46]

United States National Museum. Bulletin 167: Life Histories of North American Birds of Prey. Order Falconiformes (Part 1). By Arthur Cleveland Bent. Pp. viii+409+102 plates. (Washington, D.C.: Government Printing Office.) 70 cents. [46]

Departamento de Aeronautica Civil: Instituto de Meteorologia, Brasil. The Normal Atmosphere above Rio de Janeiro. By Adalberto B. Serra and Laura D. Barbosa. Pp. 50. (Rio de Janeiro: Departamento de Aeronautica Civil.) [46]

Svenska Linné-Sällskapet's Årsskrift. Årgång 20, 1937. Pp. v+200. (Uppsala: Almqvist and Wiksells Boktryckeri-A.-B.) [76]

Industrial Research Bureau. Bulletin No. 9: Purification of Clay. By S. R. Das and M. A. Saboor. Pp. iii+7+3 plates. (Delhi: Manager of Publications.) 6 annas; 8d. [76]

Kongress für synthetische Lebensforschung. Verhandlungsbericht über die Aussprache zwischen Aerzten, Biologen, Psychologen und Philosophen in Marienbad vom 16 bis 18 September 1936. Herausgegeben von Prof. Dr. M. Sible und Prof. Dr. E. Utitz. Pp. 208. (Prag: J. G. Calve'sche Universitätsbuchhandlung.) [76]

Ministère de l'Éducation Nationale. Enquêtes et documents relatifs à l'enseignement supérieur. 129: Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe, Année 1933. Pp. 124. 130: Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe, Année 1934. Pp. 130. (Paris: Imprimerie Nationale.) [76]

University of Washington Publications in Anthropology. Vol. 6, No. 1: The Quinault Indians. By Ronald L. Olson. Pp. 194. 2 dollars. Vol. 7, No. 1: Texts in Chinook Jargon. By Melville Jacobs. Pp. vii+27. 35 cents. (Seattle, Wash.: University of Washington.) [86]

Publications of the Observatory of the University of Michigan. Vol. 6, No. 12: The Spectrum of Nova Herculis. By Dean B. McLaughlin. Pp. 107-214+4 plates. (Ann Arbor: University of Michigan Press.) [96]

U.S. Department of the Interior: Office of Education. Bulletin: 1936, No. 12: Public Education in Alaska. Pp. v+57. (Washington, D.C.: Government Printing Office.) 10 cents. [96]

U.S. Department of Agriculture. Technical Bulletin No. 558, Soil and Water Conservation Investigations at the Soil Conservation Experiment Station, Missouri Valley Loess Region, Clarinda, Iowa. By G. W. Musgrave and R. A. Norton. Pp. 182. 20 cents. Technical Bulletin No. 561: The Effectiveness of Cultivation as a Control for the Corn Earworm. By G. W. Barber and F. F. Dicke. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.) [96]

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 148: Einige Eigenschaften von Magnesium Blech und Legierungen. Von Masaharu Goto, Mōsu Nito und Hiroshi Asada. Pp. 163-318. (Tōkyō: Kōgyō Tōsho Kabushiki Kaisha.) 1.85 yen. [106]

U.S. Department of the Interior: Office of Education. Leaflet No. 35: Essentials in Home and School Co-operation. By Ellen C. Lombard. Pp. iii+9. (Washington, D.C.: Government Printing Office.) 5 cents. [146]

Proceedings of the United States National Museum. Vol. 84, No. 3014: A New Species of Trematode from the Mud-Bel (*Siren lacertina*). By C. Courson Zeffliff. Pp. 223-226+1 plate. (Washington, D.C.: Government Printing Office.) [146]

U.S. Department of the Interior: Geological Survey. Bulletin 861: Geology of the Anthracite Ridge Coal District, Alaska. By Gerald A. Waring. Pp. iv+57+14 plates. 70 cents. Professional Paper 186-E: The Flora of the New Albany Shale. Part 2: The Calamopityæ and their Relationships. By Charles B. Read. (Shorter Contributions to General Geology, 1936.) Pp. ii+81-104+plates 16-26. 15 cents. Professional Paper 186-L: The Correlation of the Upper Cambrian Sections of Missouri and Texas with the Section in the Upper Mississippi Valley. By Josiah Bridge. (Shorter Contributions to General Geology, 1936.) Pp. 233-237. 5 cents. (Washington, D.C.: Government Printing Office.) [146]

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 13 (Items 3371-3478): January, February, March, 1937. By Ernest A. Hodgson. Pp. 269-286. (Ottawa: King's Printer.) 25 cents. [146]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 14: List of Publications on Indian Entomology, 1935. Compiled by the Imperial Entomologist. Pp. ii+40. (Delhi: Manager of Publications.) 1.4 rupees; 2s. [146]

Meddelelser fra Kommissionen for Danmarks Fiskeril- og Havundersøgelser. Serie Plankton, Bind 3, Nr. 2: The Food of the Herring in the Waters round Bornholm. By P. Jespersen. Pp. 40. 2.40 kr. Serie Plankton, Bind 3, Nr. 3: The Annual Amount of Organic Matter produced by the Phytoplankton in the Sound off Helsingør. By E. Steemann Nielsen. Pp. 37. (København: C. A. Reitzels Forlag.) [146]

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Petroleum Fuels in Canada: Deliveries for Consumption, Calendar Year 1935. Prepared by John M. Casey. (No. 780.) Pp. ii+20 (Ottawa: King's Printer.) 10 cents. [156]