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Control and Use of Poisons

THERE has recently been published the first report of the Poisons Board to the Home Secretary\*. The document contains the report proper, together with the Poisons List which the Board is required by the Pharmacy and Poisons Act to prepare, and a draft of Poisons Rules which the Board recommends shall be made by the Home Secretary. The provisional proposals of the Board were published in the autumn of 1934, and, doubtless as the result of representations since received, have been substantially modified in certain particulars in the present report. The greater part of the Board's recommendations has to do with the control of the supply of poisons to the public, but owing to the present-day widespread use of some poisons in scientific and industrial work, the contents of the report are of interest to many others than those engaged in the preparation of medicines or the sale of poisons.

The Board explains that, in preparing the Poisons List, it has so far as possible specified by name each individual substance included, and has endeavoured to avoid phrases such as "all poisonous alkaloids" which have the appearance of begging the question "What is a poison?" It has endeavoured also to avoid the use of group names, but the ingenuity of the organic chemist has compelled the adoption of an omnibus description such as 'derivatives' for some groups. It is driven to the adoption of precise technical terms in the Poisons List, and the mystification of the layman at these "words of learned length and thundering sound" is to be provided for by the publication of a detailed, non-statutory, explanatory list.

In determining the inclusion of substances in the List, the Board has had regard to the following considerations :

"The danger of death or injury following

(1) the administration of a poison for criminal purposes,

(2) the swallowing of a poison in mistake for an innocuous substance,

(3) the inhalation through ignorance or by accident of the vapours given off by a poison,

(4) the incorrect compounding of medicines containing poison,

(5) the accidental taking in too large a dose of a medicine containing a poison."

\* Home Office. Report of the Poisons Board in regard to the Poisons List and Draft Poisons Rules prepared in accordance with the Pharmacy and Poisons Act, 1933. (Cmd. 4912.) Pp. iv+62. (London: H.M. Stationery Office, 1935.) 1s. net.

Suicide is largely ruled out as a risk which can be guarded against, presumably on the ground that, though you may prevent a would-be suicide from obtaining a poison, many other means remain available by which he can accomplish his intention. Aspirin is discussed and rejected for inclusion in the List, the fatalities due to its use being insignificant when compared with the vast number of persons by whom it is used. The possible legal difficulty caused by the presence of arsenic as an impurity in many forms of matter, and of cyanides and other poisons present in plants, is left by the Board to the good sense of those concerned, the gardener purchasing *Lobelia*, for example, being thereby freed from the necessity of buying his seedlings from a pharmacist and signing the Poisons Register into the bargain. Special provision is made for the purchase of poisons by persons in charge of laboratories and generally by those requiring them for use in their trade, business or profession, so that there will be no interference with the normal business of the laboratory supplier.

An interesting proposal about which there will be controversy is that for the supervision of the manufacture of pharmaceutical preparations containing poisons. The proposal is that such operations shall be supervised by a pharmacist, a medical practitioner, a member of the Institute of Chemistry, or by a person who for three years has been engaged in such work. The basis upon which these proposals are made is that members of each of the first three classes are subject to disciplinary control, a corrective to which the holders of university degrees are not amenable. Nevertheless, a proposal which will in the future compel a graduate to subscribe to the Institute of Chemistry if he is to practise in a certain branch of industry is one which will scarcely commend itself to the universities or to the chemical profession as a whole, and it would appear that further consideration of this proposal will be necessary before the rules are actually made by the Home Secretary.

Among substances included for the first time in the List are a number of antipyretics, of which acetanilide and amidopyrine are examples. Acetanilide has largely gone out of fashion, even if it does not wholly merit the *ex cathedra* dictum of the late W. E. Dixon that "it is a drug which ought never to be given under any circumstances". The addition of amidopyrine is presumably the outcome of recently published papers upon the effects of this substance in producing agranulo-

cytosis in susceptible people, and time alone will show whether the Board has been stampeded by the chance publication of papers contemporaneously with its own work or whether it has in fact wisely anticipated a public danger. There are in the List a number of substances which in their pure state may be regarded as museum specimens: ouabain, brucine, curarine and thebaine are examples.

Some recognition of modern developments in therapeutics and their potential dangers is seen in the inclusion of the active principles of the thyroid, pituitary and suprarenal glands. Certain substances are to be restricted in their distribution to a medical prescription, among them the nitrophenols and nitroresols, which had a short-lived vogue for slimming and, owing to their uncertain action in stimulating oxygen consumption, have led to fatalities. In this class too are the derivatives of phenylcinchoninic acid, which have given rise to toxic jaundice of the liver; and the derivatives of barbituric acid, around which the "battle of the barbiturates" raged a year ago. Thallium salts might reasonably have been added, although their uncertain action has presumably led to their general abandonment in medicine in recent years.

A general survey of the report, the Poisons List and the Rules shows that the Board has performed its detailed and thankless task with great thoroughness and, it is to be hoped, with a fair measure of success. It is satisfactory to note that the personnel of the Board is largely technical, comprising physicians, pharmacists, chemists, toxicologists and agriculturists. How far representation could have been extended to include other interests and other experts is a debatable question. There obviously comes a limit beyond which selection cannot go. Nevertheless, the omission from the Board of one or more representatives of the large-scale industrial manufacturers of poisons is noteworthy, although there may well have been difficulties in the way of such an appointment, since selection among competing firms is not easy. Up to a point, the absence of such representation is compensated for by the provision in the Act requiring consultation with industrial interests before the rules are made.

It is to be hoped that this thorough revision of the poisons legislation of Great Britain will justify the pains that have been spent upon it. The revision of the List is a piece of work which badly needed doing, and it has been done thoroughly. But the

rules bear the mark of the heavy hand of the lawyer. The present "patchwork of provisions" has worked by the administering authorities accommodating themselves to the facts of the trade in poisons, while the Rules substitute for the discretion of the authorities a large number of

detailed provisions. In future, everybody concerned should at least be able to find his position set out in black and white, but there may well be some who, after a close reading of the rules, will echo the doubts of Mr. Weller's charity boy on arriving at long last at the end of his alphabet.

### Reviews

#### Physics and Mechanics of the Metallic State

- (1) *Handbuch der Metallphysik*. Herausgegeben von Prof. Dr. G. Masing. Band 1: *Der metallische Zustand der Materie*. Teil 1: *Gitteraufbau metallischer Systeme*, von Prof. Dr. U. Dehlinger; *Grundlagen des metallischen Zustandes, Physikalische Eigenschaften der Metalle*, von Prof. Dr. G. Borelius. Pp. xiii+520. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 47.60 gold marks.
- (2) *Distortion of Metal Crystals*. By C. F. Elam (Mrs. G. H. Tipper). (Oxford Engineering Science Series.) Pp. xiii+182+5 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 15s. net.

THE investigation of metals by physical methods has undergone a remarkable development during the last fifteen years. To this progress both physicists and metallurgists have contributed. On one hand, metals and alloys can now be examined over a much larger range of temperature and pressure, and in much stronger magnetic fields than was previously the case. The application of methods of X-ray analysis enables the lattice structure to be ascertained in which the positions of the atoms and the distances between them can be experimentally determined. It is now possible, in the case of any solid alloy, to determine not only the number of phases at any given composition, but also the distribution of the atoms in those phases. For this reason, the microscope and the X-ray spectrometer have become twin instruments for the characterisation of the structure of any metal or alloy. During the period in question, theoretical physicists have been paying increased attention to the problems of the metallic state. On the other hand, the new technique, devised by metallurgists for the production of single crystals of metals by a variety of methods, has placed in the hands of physicists the most perfect form of any metal for investigation. In addition, the progress of metallurgical research has rendered available a far larger number of metals in sufficient quantities for investigation than was previously the case. Add to this the fact that the

majority of metals are now available in a state of purity which exceeds 999 parts per thousand, and it will be seen that all the conditions are present for an intensive investigation of them by the best methods of physical research.

Metals are now forthcoming in two different states—the polycrystalline and the monocrystalline. The former represents what may be called their ordinary state in that it results by the usual methods of preparation. The latter can only be obtained by some form of controlled crystallisation. Some properties, such as specific heat, can be equally well determined in either state. There is no difference in the value obtained. Other properties, such as electrical resistance, which is the same in all directions in cubic crystals, but not the same in the case of non-cubic crystals, can in the former case be determined equally well on polycrystal specimens, apart from any special influence of crystal size. In the case of non-cubic metals, however, such properties can only be completely investigated with single crystals, where the directional effects can be determined. A polycrystal specimen in such a case would give a mean value if the directions of the axes are completely at haphazard. In forged and drawn specimens, however, particular directions often predominate. Finally, properties such as the intensity of magnetisation of a ferro-magnetic metal, which even in the case of cubic crystals depend on the direction, can only be determined on single crystals.

The two books under review are examples of this modern work.

(1) That edited by Masing is the first volume of a handbook of metal physics. It is divided into two parts. The first, contributed by Prof. Dehlinger of Stuttgart, is devoted entirely to a study of the lattice structure of metals. It is significant that almost all of them possess a high degree of crystal symmetry, and crystallise either in one form of the cubic or the hexagonal systems. The only exceptions are gallium, indium,  $\beta$ -tin and  $\gamma$ -manganese which are tetragonal, and arsenic, antimony and bismuth which are trigonal. The second part is the work of Prof. Borelius of Stockholm, who sets forth a detailed survey and

examination of some of the principal physical properties of metals. Limits of space do not permit any detailed reference to either of these sections. It can only be added that both of them are of great value, and will prove indispensable to students of these subjects.

(2) The second volume under notice is the work of Dr. C. F. Elam. In the author's words, the scope of the book has been limited to "an account of the changes in structure accompanying plastic deformation; changes in physical and mechanical properties; and factors such as temperature influencing these changes". A short account of the effect of heat on deformed metal is also included. The author's aim has been to avoid unnecessary experimental details and to lay stress on methods, particularly those employed in investigations of the distortion of single crystals. This monograph is written with great ability and remarkable fairness, and clear distinctions have been drawn between the facts established by experiment, the inferences to be drawn from them, and the theory of the phenomena involved. It will be found very helpful by investigators in this field of research.

Both books are admirably printed and illustrated, but has not the time come when a protest should be made against the excessive 'loading' of the paper, which adds greatly to their weight? This is particularly the case with the German treatise. It is possible, though it is more difficult, to get satisfactory results with a lighter paper, and it would make the book in question much more convenient to use.

H. C. H. C.

### Diet and Health

*Gesundheit durch richtige und einfache Ernährung.*

Von Mikkel Hindhede. Gekürzte deutsche Ausgabe von Lothar Meyer. Pp. x+196. (Leipzig: Johann Ambrosius Barth, 1935.) 5.40 gold marks.

OUR adopted standards of diet consisting of 100 gm. protein, 100 gm. fat and 500 gm. carbohydrate with an energy value averaging 3,000 calories are derived from statistics of the food consumption of families in various cities. There is no difference of opinion about the caloric value, but the amount of protein has been much discussed and agreement has not been reached. In Great Britain the special committees of the Medical Research Council and the British Medical Association have adopted 50 gm. of animal or first-class protein as the minimum to be aimed at in compiling diets.

Many years ago, Dr. Mikkel Hindhede questioned whether so much protein was necessary, and

whether it were better derived from animal or vegetable sources. He himself lived and brought up a family of children on a diet containing about 67 gm. total protein, mainly vegetable. The children were of equal stature to others and capable of great physical endurance. The cost of the diet (pre-War) was about 4*d.* a day. Country people in Europe likewise exist upon, and bring up healthy families with fine physique, on diets with even less protein. Hindhede thus came to doubt the accepted high protein standard. With the help of the vegetarian, F. Madsen, he started numerous experiments of long duration to ascertain the minimal amount of protein for maintenance. Madsen and also other subjects lived upon various low protein diets with perfect health. The most striking one was potato and fat in which the daily amount of protein was only 32 gm. This diet was also tried by the other subjects with success. It is pointed out that the healthiest and strongest men in Ireland live mainly on a potato and fat diet. Later, successful low protein experiments were made with diets consisting of coarse wholemeal bread, or whole barley, or whole oats with a little sugar and considerable amounts of vegetables and fruits, but substitution of white bread for the whole grain was a failure. The reason for the good value of the whole grain was due to the bran, which on trial was found to be easily digestible and to contain protein of high value similar to that of animal protein.

Though the amount of protein can be reduced to so low as 32 gm. a day, Hindhede does not advocate this minimum, but recommends 60-70 gm., mainly derived from whole meal wheat and potatoes, together with vegetables and fruits and occasionally some meat or fish. His simple and standard diet consists of 500 gm. coarse whole meal bread, 25 gm. butter, 100 gm. margarine, 500 gm. potato and 100 gm. whole barley meal. It yields 60 gm. of protein and costs about 6*d.* a day. Not one in a thousand, he says, would live upon this diet; everyone would wish to add to it, partly from superstition that it is inadequate and partly from its lack of palatability. Should it be supplemented by animal or vegetable foods, that is, meat, fish, milk or eggs, or by vegetables and fruits? He considers the second alternative is right, but has no objection to animal foods, except that they should be eaten in small quantities. The simple diet contains an abundance of all the vitamins and sufficient mineral salts. The addition of other foods will upset the balance. A list of foods is given. Only fat meat and fatty fish and eggs are classed as really bad. White flour and sugar and sweets and confectionery are intermediate. Whole grain, vegetables and fruits are the best foods. There is agreement, except in

regards to fat meat, fish and eggs, with the results obtained from experiments on animals.

The diet drawn up by Hindhede from his own work and experience is similar to those eaten by certain native races in the Himalayas and in certain parts of China and the East. These peoples have the finest health and physique, and do not suffer from the intestinal diseases of the European or from cancer. There seems no question but that Hindhede is right. He refers to several institutions in which children have been healthily reared on diets of a similar nature. In Leysin the best results with tuberculous patients are with those on simple and cheap diets. There are people in Great Britain who live upon simple diets of this kind, but they are looked upon as cranks. Most people, as well as the medical profession, are imbued with the doctrine of high animal protein and scarcely dare to make any alteration.

This book should be translated into English and read without prejudice by the medical profession and the public. The simple diet is the healthiest and the cheapest. The cost of food could be reduced with advantage to health. There would be improved manual work and the possibility of competition with the workers in Eastern countries. The general lack of palatability of Hindhede's standard diet can be improved by proper cooking. Numerous recipes are given; they are well worth a trial.

R. H. A. PLIMMER.

### Psychological Doctrine and Practice

- (1) *An Introduction to Theory and Practice of Psychology*. By Dr. Ll. Wynn Jones. Pp. x+308. (London: Macmillan and Co., Ltd., 1934.) 12s. 6d. net.
- (2) *Duke University Psychological Monographs*. No. 3. *Conation and our Conscious Life: Prolegomena to a Doctrine of Urge Psychology*. By Prof. Helge Lundholm. Pp. 95. (Durham, N.C.: Duke University Press; London: Cambridge University Press, 1934.) 4s. 6d. net.

(1) IN this "Introduction", Dr. Wynn Jones deals with the subject-matter of psychology from the purely psychological point of view, that is, independently of philosophical speculation and physiological interpretation, and bases his exposition throughout upon the groundwork of Spearman's well-known principles. Though he by no means neglects the work of other schools of psychological thought, the author consistently and successfully applies these principles in all the chapters of the book, which deal in the main with problems of cognition.

Dr. Wynn Jones's plan is to give the reader, and especially the university and training college student, a straightforward working knowledge of

the science, its methods of investigation, and the application of statistical treatment to its data. He accordingly introduces each topic by outlining an experiment which the student is expected to perform. (Although some of these experiments require the resources and technique of the laboratory, for the most part they need little or no apparatus, and can easily be carried out on the lines of the directions given.) The experimental data, thus presumably obtained by the student himself, but in any case already known, are next discussed at some length, and are illustrated by references to actual researches. Though Dr. Wynn Jones casts a wide net for his illustrations, it is of interest to note that many of these come from his laboratory at the University of Leeds and are borrowed from the theses of his own students. It is in these "Discussions" also that the views of other schools are elaborated, and comparisons are drawn between the different theoretical interpretations of the data that have been advanced and those which the author himself advocates. Questions upon the content of each chapter are then set for the student; and each chapter ends with a very useful bibliography. The plan is a good one, and calculated to lead the student to the desired objective.

As might be expected, Dr. Wynn Jones lays great stress upon the securing of reliable introspective and objective data in experimental conditions, and the treatment of such data by appropriate statistical procedures. Time and labour have been lost in the past by accumulating masses of data which, for lack of a statistical instrument, were not, or could not be, scientifically handled. In the same way, much statistical calculation was worthless because of faulty or irrelevant data. Neither complaint can be made in respect of this "Introduction". Dr. Wynn Jones also emphasises the importance of the study of individual differences both for the practice and for the theory of psychology.

This volume is one of the now many evidences of the fecundity of the noegenetic principles and two-factor theory upon which it is based, and of the solidity of the foundations of exact introspection and mathematical analysis upon which they, in their turn, are grounded. The principles themselves are briefly, though clearly, stated towards the beginning, and the statistical methods at the end of the book. The intervening chapters cover a wide range of psychological topics, and should prove to be of great interest and value to the student.

(2) This monograph is a closely reasoned argument in favour of a view widely held by contemporary psychologists, and to an increasing extent by general biologists, that the behaviour of

animal organisms cannot be interpreted satisfactorily on the basis of 'mechanical' concepts such as tropisms and reflexes, but at all levels of evolution requires a teleological explanation. The reasoning is largely deductive from certain principles which Dr. Lundholm postulates, but is also supported by empirical observations. The assumption must be made that all animals experience inner urges towards goals the prosecution of which will satisfy their needs; and to this the further assumption must be added that conative experiences, the impulses themselves and their consequent activities, are directed by some kind of awareness, analogous to our own, which guides them to their goals.

The thesis is also developed that specialised (instinctive) behaviour forms become differentiated from a more primitive, generalised form, in which curiosity, together with the impulses of deference or defiance towards the environment, give rise to adaptive behaviour. In the first case the animal adjusts itself to its environment; in the second it modifies the environment so as to satisfy its biological needs. The combination of these impulses working together leads to belief in the reality of the particular kinds of psychological objects that constitute the 'world' of the animal in question, from the protozoa up to man; and it implies both insight and foresight. Curiosity, again, because of a law of the "affinity of cognitive dispositions", groups together similar psychological objects whenever a specialised impulse is activated, reinstating experiences of conative cycles set up by like impulses in the past. Language provides names for such objects—'dangerous', 'valuable', and the like. But when curiosity dominates its accompanying specialised impulse, there is no such selectivity; the mind reviews a general past in which event is related to event, and the objective relations between them are apprehended. This makes the conscious planning of means towards ends possible.

The monograph, which belongs to the literature of hormic psychology, shows traces of the influence of configurationism. It is both suggestive and stimulating.

#### Naturalists on African Lakes

*Inland Waters of Africa: the Result of Two Expeditions to the Great Lakes of Kenya and Uganda, with Accounts of their Biology, Native Tribes and Development.* By S. and E. B. Worthington. Pp. xix+259+40 plates. (London: Macmillan and Co., Ltd., 1933.) 15s. net.

DR. AND MRS. WORTHINGTON still found the place and occasion when the feel of a rifle was 'comfortable' during the night. They

were also 'roasted' in places fit for no human life, ran constant and inevitable risk in their small boats on great lakes, and had marmalade for breakfast in one of the special hells they saw fit to visit. Such things make good reading, but cannot well be introduced into scientific papers, or official reports, and the authors have done a service in writing a general book, where the reader can find both enlightenment and entertainment.

A further and better justification is that travellers, and especially such travellers, inevitably make many important and suggestive observations in geography, anthropology and natural history, which are not perhaps sufficiently complete or novel for scientific papers, but, when put together in this way, provide a very good picture of African life. This will be of historical importance in only a few years' time, so rapid are the changes of the present age in Africa. The fathers of some of the Worthingtons' most skilful clerks or artificers may have been cannibals. What will the sons be?

Specialists and other students should look in this book for readable and, no doubt, very fair accounts of some interesting subjects. A survey of primitive craft, culminating in the Baganda canoe, suggests evolution rather than dispersion. The decay of communal emotion, in favour of individual emotion, is traceable in a comparison of dances, of which a very fine account is given, including the music. Canoe songs are not as well done as might have been expected, although it is good to have a record of the "Song of the Crowned Crane".

The changes in watersheds, with pluvial periods and earth movements, are well summarised in connexion with the distribution of species of freshwater fishes, the last in itself a fascinating problem. Angling, food chains, farming the waters and artificial dispersion of species, are serious problems described. The account of the solution of the *Tilapia* problem in Lake Victoria reads: "Constant fishing every day throughout many years in the Kavirondo Gulf had reduced the stock of fish to such an extent that their breeding had been seriously affected"; whereas the senior member of the Lake Victoria survey wrote, referring to the whole lake, ". . . this diminution of stock has not yet gone so far as to reduce the number of ngege that annually enter the fishery" (1929, p. 11).

The book is well printed, but would have been easier to read had the lines been further apart. Clear maps are in sufficient quantity and the photographs are interesting and beautiful, which means that serious difficulties of the tropics were surmounted. There is an index. M. G.

## Short Notices

*An Index to the Genera and Species of the Diatomaceae and their Synonyms, 1816-1932.* Compiled by Frederick Wm. Mills. Part 1: *A-Ac.* Pp. 74. Part 2: *Ac-Am.* Pp. 75-148. Part 3: *Am-At.* Pp. 149-222. Part 4: *At-Bi.* Pp. 223-296. Part 5: *Bi-Ch.* Pp. 297-372. Part 6: *Ch-Co.* Pp. 373-448. Part 7: *Co-Cy.* Pp. 449-526. Part 8: *Cy-Di.* Pp. 527-606. Part 9: *Di-Eu.* Pp. 607-684. Part 10: *Eu-Ga.* Pp. 685-762. Part 11: *Ga-He.* Pp. 763-840. Part 12: *He-Me.* Pp. 841-920. Part 13: *Me-Na.* Pp. 921-1000. Part 14: *Na-Na.* Pp. 1001-1080. Part 15: *Na-Na.* Pp. 1081-1161. Part 16: *Na-Ni.* Pp. 1162-1240. Part 17: *Ni-Pl.* Pp. 1241-1320. Part 18: *Pl-Rh.* Pp. 1321-1400. Part 19: *Rh-St.* Pp. 1401-1480. Part 20: *St-Sy.* Pp. 1481-1570. Part 21: *Sy-Z, Appendices, Supplement.* Pp. 1571-1726. (London: Wheldon and Wesley, Ltd., 1933-1935.) 10s. each Part.

Two groups of minute plants, the Desmids and the Diatoms, have long been subjects of study for those attracted by the elucidation of microscopic detail, and in both cases numerous species have been described and a complex synonymy has resulted. An index to the species and synonyms of Desmids was published by Nordstedt in 1896 and has been of great value to workers on the taxonomy of these forms. The fact that nothing altogether comparable has up to the present time been accomplished for Diatoms is no doubt to be ascribed to the wider range of literature to be traversed and to a more entangled synonymy. The labour involved was in fact much greater and Mr. Mills, whose index has been compiled over a long span of years, is to be congratulated on the successful achievement of so arduous a task.

Since a work of this kind has a permanent value rather beyond the average, one cannot but regret that it is not printed, for even at this early date an appreciable proportion of the pages of the typescript bear so feeble an imprint that it may well be doubted whether they will be readily decipherable fifty years hence. It is to be hoped that before then means will be found to secure a more permanent reproduction, for which the Royal Microscopical Society, to the fellows of which the work is dedicated, may perhaps be able to raise the requisite funds. The first part contains numerous typographical errors, a defect which is to be regretted since this part includes the principal bibliography. The final part contains a supplement with additional literature and a series of species omitted in the main body of the work.  
F. E. F.

*Ancient Ireland: a Study in the Lessons of Archaeology and History.* By Prof. R. A. S. Macalister. Pp. xii+307+24 plates. (London: Methuen and Co., Ltd., 1935.) 10s. 6d. net.

In introducing "Ancient Ireland" to his readers, Prof. Macalister explains that it is in effect a supplement to his "Antiquities of Ireland", which appeared

in 1927. He now approaches the material with which he dealt in the earlier work from a more anthropological point of view. He has here essayed a reconstruction of the cultural history of Ireland from prehistoric down to historic times, including in his survey the renaissance of Celtic art in Christian times and the early churches and castles. For the detailed evidence, upon which this reconstruction is based, the reader is referred to the earlier volume. On certain topics, however, such as the origin and purpose of the prehistoric forts of Aran, the origin and meaning of New Grange, oghams and other matters, fresh evidence or a change of view have necessitated a restatement and recapitulation.

One of the most important of such matters to which the author has given reconsideration is the break in bronze age culture, which the evidence of pollen analysis, not available to him at the time of writing, has now shown to come at the close of a climatic optimum. In attributing the cultural eminence of the early bronze age not merely to wealth in gold, but also to the effects of a more favourable climate, the author has stressed an influence which he sees at work throughout Ireland's cultural history, and holds responsible for the cultural break between north and south—a break marked from the earliest times as in the distribution of the horned cairn, down to the present political division between Northern Ireland and the Free State, in which a bracing north-east is opposed to the enervating south and west.

On many questions—not least, perhaps, on the Celtic problem itself—Prof. Macalister finds himself at a loss, in view of the gaps in systematic study of Irish antiquities. The present activities of the State may possibly hold out promise of better things. In the meantime, Prof. Macalister, with his many and often brilliant suggestions, offers a plenitude of material for further discussion. He never fails to be provocative, even when most convincing.

*Hormone und innere Sekretion.* Von Prof. Dr. Fritz Laquer. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 19.) Zweite verbesserte und bedeutend erweiterte Auflage. Pp. xii+368. (Dresden und Leipzig: Theodor Steinkopff, 1934.) 18 gold marks.

THE second edition of this very thorough work of reference follows seven years after the first. Dr. Laquer (who should not be confused with Dr. Laqueur, the distinguished Dutch physiologist working in the same field) has himself been very active in hormone and vitamin research, and it is all the more creditable that this should not have involved the restriction of his bibliographic activities.

The present book is an extremely useful consequence of those activities, covering, with abundant references and literature indexes, the whole field of endocrinology in its chemical and physiological

aspects. To have done this in 368 pages, which include 6 pages of index and 126 pages of literature references, involves immense condensation, and leaves little room for any expression of the author's own opinions. Perhaps, in a field where to-day so much is speculation and controversy, this is not altogether to be regretted. An indication of the relative apportionment of subject matter can be obtained by considering the bibliographical references. To the general section there are 123; to the sections on the enzymes of the pancreas, thyroid, parathyroid, adrenal, pituitary, reproductive, and miscellaneous glands (including the thymus, spleen, intestinal tract, pineal body, etc.) there are respectively 1,245, 1,000, 337, 1,092, 1,237, 910, 688.

For these references alone the book is one to be welcomed; it is only the specialised experts working in each individual field who can precisely assess the value of the book in its particular aspects.

A. L. B.

*The Application of Absorption Spectra to the Study of Vitamins and Hormones.* By Dr. R. A. Morton. Pp. 70+6 plates. (London: Adam Hilger, Ltd., n.d.) 10s. net.

THIS small volume, which deals mainly with vitamins and scarcely at all with hormones, gives a concise and excellent summary of the achievements of absorption spectroscopy as a valuable adjunct in the isolation and identification of naturally occurring compounds which are present in extremely low concentrations. Dr. Morton's own investigations have played a prominent part in relation to the work on vitamins A and D, and it is unfortunate that the relatively high price will prevent this book from finding its way into the hands of many biochemical research workers who would find much of interest and of value in its pages.

The book is usefully illustrated by plates and figures, and a noteworthy feature is the table of carotenoids and their distinguishing properties. The amazingly rapid progress now being made in the chemistry of the vitamins and hormones is responsible for the fact that some of the sections are already out of date to some extent. Various phases in the application of spectroscopic methods are well brought out: first, the uncertainty as to the significance of the absorption bands given by crude extracts; then the use of the characteristic spectrum in the concentration of the active principle; and finally, the application to the quantitative evaluation of the vitamin.

*The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1935.* Edited by Dr. M. Epstein. Seventy-second Annual Publication: Revised after Official Returns. Pp. xxxvi+1488. (London: Macmillan and Co., Ltd., 1935.) 20s. net.

THE new edition of this well-known book of reference maintains the familiar arrangement of past years, which gives rather more than a third of the book to the British Empire and the United States, and

the remainder to the other States of the world with their Colonies and Dependencies, arranged in alphabetical order. The account of each State ends with a long list of useful books and there is a voluminous index to every place name. The volume has undergone the usual thorough revision and contains a marvellous array of recent statistical matter relating to area, population, finance and trade, besides ample accounts of constitutions and Governments. Unsettled as the state of the world is at present, there have been no transferences of territory of importance except the Saar, no emergence of new States and no disappearance of old ones during the year. Manchuria still appears under its old name as a territory of China, although a coloured map shows Manchukuo according to Japanese sources. A second coloured map shows the Saharan area ceded to Italy by the Anglo-Egyptian Sudan in the Libyan boundary settlement.

*L'Espèce, la race, et le métissage en anthropologie: introduction à l'étude de l'anthropologie générale.*

Par Henri Neuville. (Archives de l'Institut de Paléontologie humaine, Mémoire 11.) Pp. iii+515. (Paris: Masson et Cie, 1933.) 200 francs.

THE publication of an intensive study of 'race' and attendant problems is a new departure for the Institut de Paléontologie, which the author justifies by his views of its relationship to the objectives of the study of human palæontology and archaeology. M. Neuville's interpretation of the result of the geographical position of Europe and its function as a terminal point in racial migration is illuminating in relation to the consideration of the origin and distribution of racial characters in that continent.

The most important section in this study of race, however, is that which covers the study of material relating to the crosses of different races, in which the valuable but not too well-known data from the French colonies of Annam and Tonquin and West Africa are set out and considered in some detail.

*A Text-Book of Quantitative Chemical Analysis.* By Dr. A. C. Cumming and Dr. S. A. Kay. Sixth edition, revised by F. C. Guthrie and J. T. Nance. Pp. xv+482. (London and Edinburgh: Gurney and Jackson, 1934.) 15s. net.

ORIGINATING in 1913, this book has now reached its sixth edition—no better testimonial can be desired. The revision has been undertaken by Messrs. Guthrie and Nance, both lecturers in the University of Liverpool. Needless to say, the book has been brought up-to-date, for there is progress in this as in other branches of chemistry. Very properly 'ml.' has been substituted for 'c.c.' The changes which are indicated in the preface include recent methods for calibrating volumetric apparatus and determining hydron concentration. The enhanced use of electrolytic methods is given due attention and the same applies to colorimetric methods, for which a number of new reagents have been described. In addition to what may be described as general analysis, the book has chapters relating to the analysis of ores and alloys, of gas and water.



## Chemical Industry and Carl Duisberg

By PROF. HENRY E. ARMSTRONG, F.R.S.

"ALAS, poor Yorrick! I knew him, Horatio: a fellow of infinite jest, of most excellent fancy. . . ." Geheimer Regierungsrat Carl Duisberg, honorary university senator, professor and doctor in all faculties, including theology, was born on September 29, 1861; he died on March 19, 1935. In telling his story, the history is told in large part of the most intricate and far-reaching of modern industries—also the history of an unparalleled advance, due wholly to the considered use of scientific endeavour by a nation, an advance involving incidentally a vast increase in man's knowledge of himself, of his power over himself and the world—all this the growth of only four fifths of a century! Curiously enough, the up-growth of Germany as an industrial nation has been almost coincident with that of Japan. Whilst, however, the constructive advance of Germany has been intellectual and original, the advance of Japan has been imitative and mechanical: she has given no evidence of any special intellectual advance, such as has been apparent in India, for example, in a remarkable development of mathematical physics. It is, however, possible that we are too simple-minded to plumb her actions. Being free from our Western traditions and prejudices, especially from our stubborn individuality, maybe the Japanese have fathomed the value of scientific method, indeed of method in general, as we certainly have not: that consequently they are working to a clearly conceived plan. If so, they will be very dangerous as rivals. At least, they have the courage of their convictions and do things.

At the moment, Germany is abandoning the method to which she owes her success: Is she to continue on the down grade or to recover her liberty of thought and action? Is Japan likely to advance sufficiently in intellectual power to sustain the great burden she has undertaken: is this not already too heavy? May it not be that her arrogance comes from the fact that the old military element is regaining ascendancy? Having been a student in Germany before the war of 1870; having soon afterwards had as colleagues two of the men who shortly before had been instructors of the Japanese in our Western arts, I have long been more than an interested observer of the march of events. The one great point in favour of the Japanese is that they seem to be able to learn a lesson; our European characteristic is that we cannot and that our rulers are ascetic—playing dangerously only upon the credulity of the masses, without understanding the true state of affairs.

By Carl Duisberg's death, Germany is deprived of one of the greatest and most valuable citizens she has ever had; in the legend of the future, he may well come to be considered the most efficient and effective industrialist the world has yet known—he played with consummate skill so varied a part, with such unusual forcefulness of character, clearness of understanding and breadth of outlook, ever with entire devotion to his country and to his chosen and beloved science. The foundations of his success were certainly laid at the university, in Germany long the accustomed resort of the intelligent, including the upper commercial class—not the mere scholarship-fed, aimlessly competitive racing stables into which we have allowed ours to drift.

The story of Duisberg's early career is profoundly interesting. His father, a silk riband manufacturer and merchant, wished him to enter the business but he was attracted to chemistry while still at school. Leaving properly early, he went to Göttingen, then to Jena. He had taken his degree when he was twenty, before the close of his sixth semester. At Göttingen, he first came under Jannasch, who set him to work at complex analysis. In the second semester he was under Hübner, who used him to study the bromination of benzoic acid. Finding, at the end of the year when he almost had a thesis ready, that he could not take a degree at Göttingen, as he had been at a non-classical *oberreal-schule*—moreover, that in any case he must continue his studies during four more semesters—he went to Jena. He most fortunately came under Geuther, long an assistant to the great Wöhler, the steadying philosophic influence in the Liebig-Wöhler partnership. Geuther was incensed when he learnt how Duisberg had been treated—that he had had no drill in preparation making. He insisted on his going through a full course of disciplinary exercises, both inorganic and organic, in laboratory technique, making him work with the simplest means. Eventually he gave him a theme for his doctorate—of course, dealing with aceto-acetic ether, of which Geuther (together with Frankland and Duppa) was the discoverer. His chief subject was chemistry, with geology, mineralogy and national economy as secondaries—in choosing the last the child was father to the man.

Having taken his degree, anxious to be independent of his father, without informing his teacher, Duisberg sought and obtained a post in the public food analytical laboratory at Crefeld. Evidently seeing how great was his ability, Geuther

indignantly insisted that he must not so demean himself. He had no assistantship vacant but made him his private assistant, according to Duisberg's own statement, in his obituary notice of Geuther (*Ber.*, Oct. 15, 1930), at the princely pay of 80 marks—instead of the usual 100—with a garret above the laboratory to live in. In the book issued at the time of his seventieth birthday ("Carl Duisberg, ein deutscher Industrieller"), Duisberg is made to say that he was paid 1,000 marks, instead of the usual 1,200, plus the garret. So is history written! Geuther stipulated that he should not leave him until he obtained a suitable industrial post. The year must have been invaluable to him. The curtain fell dramatically on the smash of glass! Finding that no one would employ him until he was *militärfrei*, Duisberg decided to join up at Munich. Geuther, when told of his intention, bitterly resented his leaving, insisting that he must keep his bargain. The end came one day when, after angry discussion at his bench, Duisberg followed his master out of the laboratory brandishing in his face a large globular flask which he had been cleaning; eventually, as he reached the door, flinging this violently at his feet. Repentance came at once. Calling upon the Rector, he told him what had happened and that he feared Geuther would make it impossible for him to become an officer. Evidently the Rector sympathised, as he advised him not to take the occurrence too seriously but to go to Munich. Such was the dramatic ending of his university career. He left magnificently trained.

At Munich, while serving as *Freiwilliger*, Duisberg worked in his spare time under von Pechmann; probably he was a little too lively for Baeyer. At the end of this year of military service, he was engaged, with two others, by Karl Rumpf, head of the *Farbenfabriken vormals F. Bayer & Co.*, Elberfeld. Owing to the slump in alizarin, the firm was in queer street, paying nothing. Rumpf gave his assistant his first real lesson in economics, teaching him that it was necessary to spend in order to earn. The three young men were sent to different university laboratories, as no place could be found for them in the works. Duisberg went to Fittig's laboratory at Strassburg; history does not tell us what happened—they were very opposite characters. He began work on the synthesis of indigo, without result. He then passed over to the study of azodyestuffs from benzidine and made orthotolidine, its next homologue. At the end of a year, in the autumn of 1884, he entered the factory at Elberfeld, never to leave the firm except to translate it from a narrow, confined valley to a great open site at Leverkusen on the banks of the Rhine, taking no mean share of Rheingold treasure by so doing.

He rose to gain for the firm a position as high as that attained to by any of its great rivals; moreover, not only to be its head but also the head of German chemical industry in general; in fact, he became a great man of affairs.

Why is it that, with very few exceptions, our chemists insist on remaining public nobodies and play but an underground part in industry? Duisberg was made by his university training, as not a few of his countrymen have been. We cannot point to a single similar success of our ancient universities in constructional industry. Can we doubt that the competitive, superficial, unimaginative training—mere knowledge worship—now given at these, following upon the neglect of all scientific training at our monastic, certificate-hunting public and other schools, is the main cause of our continued failure? Notwithstanding the lesson we have had, our industry to-day is in no way efficiently officered. The Germans have known what *Lern* and *Lehr-freiheit* are—their success has been due to the way in which their universities have been free institutions. Now they are being deprived of them. Freedom is an unknown quantity to-day in our schools; half a dozen examiners control them all and make them pipe to one tune. No experiment can be made. Until and unless we place education under liberal, scientific control, until we displace the clerical type of mind by the practical, no progress will be possible for us. We are doing nothing to develop and cultivate our innately practical intelligence; instead we are sterilising it by mere book worship. In consequence of our training, our so-called science on the theoretical side is mere faith worship; dogmatic and doctrinal, not eternal doubt; no thought of public need behind it.

Duisberg came upon the scene at a propitious time; the fates conspired to help him. It is an interesting fact that his first technical work was inspired by a message from England—from a house-top in Burton-on-Trent, the roof laboratory of the chemist at Allsopp's brewery, Peter Griess, the father of diazo-chemistry and of the azodyestuff industry, in virtue of the work he did while assistant to the great Hofmann at the College of Chemistry, Oxford Street, afterwards at Burton-on-Trent, in amplification of the discovery which he had made when a student at Marburg. Griess had submitted proposals to the Bayer firm for the preparation of certain benzidine sulphonic derivatives and their use in making azodyestuffs. The task was placed in Duisberg's hands to develop technically. Beginning at Strassburg, he continued the work when he joined the Elberfeld factory in September 1884. He soon succeeded where others less skilled had failed in preparing Griess's benzidine-sulphon-disulphonic

acid and in making from this a dyestuff for wool, *sulphonazurin*, which was patented in their joint names. Although this did not answer expectations, the way was prepared, as the Elberfeld atmosphere became charged with benzidine nuclei.

On February 27, 1884, Paul Böttiger, up to the end of 1883 in the employ of the Bayer firm, patented the dyestuff which was to become known as Congo Red, the first dyestuff discovered with which it was possible to dye cotton directly. I have reason to believe that Griess had previously made this and discussed its merits adversely with his friend Heinrich Caro, a leading member of the great Badische Anilin und Soda Fabrik, who, however, with Dr. Martius, had gained his experience in dyestuff chemistry, in Manchester, with Roberts, Dale & Co. Both the Badische and Duisberg's firm declined to purchase the patent. Böttiger then offered it to Dr. Martius's firm in Berlin. Martius was also about to decline it, when a friend, a dyer, happened to call upon him and noticed the dyed samples upon his desk; being told of its properties, he displayed great interest in the dyestuff on account of its power of dyeing cotton directly.

The Berlin firm secured the patent and soon put the dyestuff upon the market as Congo Red. It excited the greatest interest among dyers, although supersensitive to acids, because of its special behaviour to cotton. Bayers were naturally sore, and it is easy to imagine the chagrin of young Duisberg at having so high a trump taken out of his hand. He at once hoisted the Jolly Roger, which was to become the flag of the industry. The dyestuff had two components *A* and *B*. It was open to him to vary either. He chose to vary *A*, benzidine, having already made its first homologue, ortho-tolidine. Here he all but failed to recognise that he again held trumps. In his first trials, he obtained only a brown mess, of no promise. He had the habit, however, of putting his beakers aside as he used them, clearing up only at the end of the week. When doing this, he noticed that the brown mess had turned into a scarlet. Following up the clue, he discovered that the coupling of *A* and *B* took place only very slowly. In thus discovering Benzopurpurin, he made the first effective, direct cotton dyeing dyestuff.

A new field was doubly disclosed—up to that time no systematic use had been made of homologues. On this account, much difficulty was experienced in securing a patent. The Martius firm naturally objected to such a rival to Congo but in the end the two firms agreed to work together. Then a rival firm that had been cited for infringement of the Congo patent brought an action to invalidate the patent. In the end, all

opposition was overcome and the patent declared valid largely through Duisberg's own enthusiastic pleadings before the expert court. His value to the firm was greatly enhanced through this. Benzopurpurin, being far less sensitive to acid than Congo Red, was a great commercial success. In the second year of its manufacture, Duisberg's share of the profits was already 10,000 marks (£500), which he at once invested in the firm's shares.

The effect of Duisberg's success was to stimulate, in an astounding degree, the development of systematic, scientific laboratory inquiry as chief objective of the industry. The Bayer firm, under his enthusiastic guidance, may be said to have led the way. Not only were new dyestuffs produced in endless variety of colour and shade, their use was also systematically studied in the dyeing laboratory. The British dyers became mere tools of the German dyestuff makers, though lubrication with no little palm oil was needed to overcome their intense conservatism and rule of thumb methods.

Duisberg had no little luck. The opening up of the tetrazo-field involved a great extension of the range of synthetic dyestuff colour. The diazo-colours previously on the market had been yellows and reds; Congo made from aminonaphthalene-sulphonic acid was also red. Substituting naphthol-sulphonic acid for the naphthylamine acid, so increasing the light absorbing power of the dyestuff, Duisberg obtained a blue but of an undesirable red shade. He relates how, sleeping at home after lunch (he had not yet an orchard), he dreamt that if he were to displace the methyl in ortho-tolidine by methoxyl he would introduce a green shade and so obtain a blue akin to indigo. The dream came true. He was beginning subconsciously to theorise about the conditions determining visible colour. Accident was to carry him still further. In manufacturing the dyestuff, large quantities of paranitrophenol were accumulated; this was put into casks and kept for a rainy day. Various attempts were made to find a use for it, without success—until one day the news came that two medical men had been poisoned by a druggist mistakenly dispensing acetanilide for naphthalene. This led to the recognition of the antipyretic value of acetanilide and to its sale by Kalle and Co. as Antifebrin in large quantity. Why not ethylate and reduce paranitrophenol, said Duisberg. He therefore had it converted into ethoxyacetanilide, phenacetin. This proved to be even better than antifebrin. In undertaking the manufacture of phenacetin, together with that of sulphonal and trional, the firm embarked upon a new important branch of activity, in which they became leaders. Aspirin followed in a remarkable

way. Some genius in the firm, if not Duisberg, bodily lifted into a patent specification a paper in *Liebig's Annalen* describing the preparation and properties of acetylsalicylic acid. Of course, the patent was lost when attacked in the Courts—but no matter. The name *Aspirin*, which Duisberg had registered as a trade mark, still remained and gave the holders almost a monopoly. What's in a name? Everything! Names are not all equally sweet. The challenge to take an Aspirin is easily uttered—no one would think of asking for an Acetylsalicylic acid. Duisberg always prided himself upon being a judge of 'technical effect'; in no other case was this better shown.

Gradually, as the firm prospered, Duisberg's productive activity as chemist gave way to a more general activity. In 1900, he entered the directorate and became mainly occupied in erecting a great new works at Leverkusen, which in every particular bears witness to his creative ability. He was particularly proud of the provision he made for the welfare of the workpeople. After the War, he was largely occupied in the first place in organising the dyestuff industry; then German chemical industry as a whole—a task for which he was eminently suited by his masterful character, his great experience and above all his organising ability. The appreciation showered upon him on the occasion of his seventieth birthday was overwhelming in extent and sincerity.

Duisberg was much helped by Henry Böttinger, who had married into the firm before he entered it. Up to the time of his majority, Böttinger had lived at Burton-on-Trent, where his father was chemist at Allsopp's brewery. He was so entirely anglicised, that he spoke German as if he were thinking in English. He took charge of the firm's external affairs and laid the foundation of their great success in Eastern markets. I have a presentation copy of a tremendous quarto tome, beautifully got up entirely in the works, a lithographed reproduction in script of the letters Böttinger wrote home to his family during his travels in India and China. He not only placed the firm's goods but also arranged for training centres in India at which instruction in dyeing was given to buyers of their dyestuffs. The use of native-grown vegetable dyes in the East was thereby greatly curtailed. Now indigo is almost supplanted by synthetic indigotin, although if the industry were organised the natural dyestuff could be produced with advantage. Böttinger was so active-minded that later on he became a Member of Parliament. Eventually, he was *veradelt*.

I have sketched Duisberg's character more than once: during the War, in *The Observer*; in *Chemistry and Industry* (March 27, 1931), apropos of an obituary notice of his great master Geuther

which he had written for the German Chemical Society; recently (March 29) in *The Times*. He must have been a lively youth. When I first knew him, soon after he went to Elberfeld, in the first blush of his success, he was the perfect Gascon, filled with an astounding conceit—really this was his great asset. So late as 1906, at our celebration of the jubilee of Perkin's discovery of the first aniline dyestuff, with complete unconcern and full belief in his words, he told us that we must regard Germans as God's own chemists, heaven sent beings with whom it would be absurd for the world to enter into competition. Some of us smiled. We had discussed our position and long lamented our commercial weakness. Perkin, it is true, had been beaten from the field. Still, he had to his credit not only that he had made his discovery but had also started works by the time he was nineteen, without any Geuther to train him. Later, he was the first in the field as the maker of alizarin. Faraday, in 1825, had discovered benzene and analysed it accurately, even made the two naphthalenesulphonic acids out of which Teutonic chemists were to win fortunes; he had done not a little other chemical work. Lancaster had bred a chemist in Frankland. Personally, I had played to some effect with naphthalene and knew something of the colour game. I did not despair of our some day again wearing the shoes we had cast off too early; I knew we had recruits in the background. In fact, when Duisberg addressed us, the spirit was already at work in our Teutonic friends that made the late War inevitable. His own son, in saying "Good-bye" to my sons, in Lakeland, not very long before the War, expressed the hope that at no distant date he would meet them "on the field"; he even looked forward to becoming part owner of Derwentwater. This is sober fact. The German is a complex character. As chemists, it is essential for us to learn to dissect out the elements of his mentality. Having spent nearly three years as a student in Germany before the War of 1870, I have been witness of some of his interactions. Before '70, they were a primitive, almost pastoral, music-loving nation, wonderfully intelligent and absolutely indefatigable workers, asking only to be well led and ever willing to be led, almost child-like in their simplicity. On the other hand, they were curiously lacking in sense of proportion and without humour; you had not far to go below the surface to meet with unpleasant if not barbaric reactions, such as Wagner has brought out most wonderfully in his tetralogy—such as the Red Queen saw in Alice: "A nasty vicious temper".

Duisberg had lacked the critical power, characteristic of his nation, to see sufficiently below the surface. He knew quite well that our failure was

mainly commercial and that our university system was greatly in fault. He was too much overcome by his countrymen's overwhelming success in the industrial field; he did not see that no real attempt had been made by the world to meet their competition. The world, in fact, had been hypnotised by Germany's ordered progress.

Our action after the War was stupid. We allowed lawyers to put themselves in charge. These were followed by so-called business men. We have yet to give technical knowledge and efficiency their due place. This will ultimately be our sole chance of securing our proper share in the world's work. Our recent partial success in re-establishing the dyestuff industry may largely be attributed to the example set by Mr. James Morton, whose acute mind led him to surround himself with a picked band of competent workers and to accept their guidance unreservedly. The outstanding service rendered by his chief assistant, the late Dr. Thomas, has yet to be sufficiently recognised; he was the nearest approach to a Duisberg we have had. We have to take pains that we may breed such men—at present our schools are worthless for the purpose—indeed,

they prevent them from arriving. If our industry is to prosper, we must abolish all clerical control of education and put it under men of scientific outlook—men who not only know something but also know how to use knowledge. The present ignorance of the schools will never give us this. The future of the dyestuff industry will depend entirely upon the attitude of the public towards colour—upon the development of the colour sense. The present world tendency is to abandon colour—everywhere black prevails: an almost lost sense has to be recovered.

Chemists belong to no nation: the world over they are a community; one in spirit, in thought and in method, interdependent in their work. Eventually they must lead the world, as they alone can understand its operations. The service Duisberg rendered was to the common good. All can recognise the worth of the man, apart from his nationality; the value of the great example he set, apart from his technical service, by the exercise of a wide public activity and a wide philanthropy. Only by the aid of such men will the world eventually be sufficiently brought together in harmonious interrelationship.

### Quantum Mechanics as a Physical Theory

THE issue of the *Physical Review* dated May 15 contains a contribution by Prof. A. Einstein, B. Podolsky and N. Rosen under the title: "Can Quantum-Mechanical Description of Physical Reality be Considered Complete?" The authors answer this question in the negative. They begin by pointing out that it is important to draw a distinction between the physical concepts, which are introduced into a theory and form its subject matter, and the objective reality, which is independent of the theory and which it is the purpose of the theory to describe. That is to say, we have to draw a distinction between the results of experiment and our theoretical description of them.

In order to test a theory the authors ask two questions: (1) Is the theory correct? And (2), Is it complete? The content of the paper is a consideration of the answers obtained when these questions are applied to quantum mechanics.

The first question can be answered in the affirmative if the theoretical conclusions agree with experiment. In physics, we test correctness by means of numerical values, and in this respect the authors have no adverse criticism to make of the quantum theory. The second question is a more difficult one, and some explanation of its meaning is required before an answer can be attempted.

A complete theory is understood to be one which provides a counterpart to each element of physical reality. The definition of physical reality lies at the root of all that follows in the paper. The authors say: If, without in any way disturbing a system, we can predict with certainty the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity. They accept this as a reasonable criterion. They do not regard it as a necessary but as a sufficient condition of reality.

Accepting this definition, the authors go on to show that the quantum-mechanical description of physical reality is not complete. The first step in the argument is to show that the uncertainty principle places two alternatives before us. Suppose that two physical quantities are represented in the theory of quantum mechanics by the operators  $A$  and  $B$ . If these operators do not commute, that is,  $AB \neq BA$ , then the theory maintains that precise knowledge of one quantity is incompatible with precise knowledge of the other. The best known example of this is that in which the physical quantities are the co-ordinate of position and the momentum of an electron. We can only obtain precise knowledge of the second quantity by experiment, and in attempting this we destroy

our knowledge of the first. But both operators represent objects of physical reality, so that by the definition it must be concluded either that the theory does not contain concepts for both, that is, it is incomplete, or else the two quantities have not physical reality at the same time. In quantum mechanics it is assumed that the wave function contains a complete description of this reality for the state to which it corresponds. This is reasonable, since the information obtainable from this function corresponds exactly to that which can be predicted with certainty without altering the state of the system.

In the final stage of the argument, an appeal is made to the process known as reduction of the wave packet. We must refer to the original paper for the details, but it is deduced that it is possible to predict with certainty two quantities corresponding to physical realities, and moreover that these quantities are represented by non-commuting operators. Thus we have to admit that if the quantum theory is complete and therefore contains concepts for these quantities then, although non-commuting, they correspond simultaneously to physical realities.

We saw that the uncertainty principle presented us with two alternatives; and now we see that if we deny the first of these alternatives, we have also to deny the second. The conclusion is that the first alternative, that the quantum theory is incomplete, has to be accepted.

It is possible that the criticism does not strike at the root of the quantum theory, since so much depends upon a definition of physical reality, which is not of necessity included in the theory. If we could be satisfied that the definition is necessary or that without it two simultaneous conjugate physical quantities are represented by

commuting variables, then the quantum theory fails. An interesting letter on this point from Prof. G. Temple appears in NATURE of June 8 (p. 957).

The paper by Einstein and his collaborators is rather to be regarded as an appeal for a more direct description of the phenomena of physics. The authors seem to prefer the artists' portrayal of the landscape rather than a conventional representation of its detail by symbols which bear no relation to its form and colour. The expression of a belief that it is possible to provide a complete description of physical reality indicates the nature and purpose of the criticism. Presumably the appeal is for a replacement of the operator calculus of the quantum theory by a method of description which resembles that of the classical and relativistic theories in that, like them, it introduces concepts more directly corresponding to physical realities.

In criticising quantum mechanics in this way, we must remember that it arose out of the inadequacy of existing models, and it has evolved in its particular way because it has had to do without them. The theory has done what, in the face of difficulty, it set out to do. It does not profess to describe actual phenomena but the possible results of measurements, and it is particularly concerned with the influence of the observer on the quantities observed. Much work is being done at present on the notation of the quantum theory. There are difficulties to be removed and with their removal we may find that we have travelled in the direction desired by the three authors. Physicists can scarcely remain content with a situation in which the electron is an equation, and the remark sometimes heard that the school of quantum mechanics is content to establish itself merely as a bureau for ready reckoning is by no means true. H. T. F.

### U.S. Stratosphere Balloon *Explorer II*

A BRIEF reference was made in NATURE of February 23, p. 299, to the remarkable preparations afoot in the United States to launch a new attempt in stratosphere research following on the mishap to *Explorer I*. News has now come to hand that everything was ready by June 1 and the balloonists are only awaiting favourable weather conditions. The outstanding feature of this new experiment is the display of co-ordination of effort on the part of the National Geographic Society, the U.S. Army Air Corps and many of the public bodies interested in research. Capts. A. W. Stevens and O. A. Anderson will again ascend, and Capt. R. P. Williams is in charge of ground operations and has been named as alternative pilot.

Some idea of the magnitude of the task can be gained from the following details of the balloon and the experiments.

#### BALLOON

This was built and designed by the Goodyear Zeppelin Corporation, Ohio. When inflated it is 192 ft. in diameter and has a capacity of 3,700,000 cub. ft. and an area of  $2\frac{3}{4}$  acres. Its initial charge will be 300,000 cub. ft. of helium, and with this 'bubble' of gas in it the top will rise 316 ft. from the ground when it is all complete and ready to start. The envelope is made of rubberised fabric, most of it weighing 5.3 oz. a square yard, at the top 7.2 oz. a square yard. The gas can be released

by two pneumatically operated valves near the top and there are four inverted open canvas chimneys in the bottom, 7.5 ft. in diameter and 17 ft. long, to relieve it of surplus gas when fully inflated by the reduction of the external pressure.

The total lift of the balloon on the ground is more than 8 tons. This figure includes the weight of the balloon itself, men, equipment and ballast. The gondola is 9 ft. in diameter and weighs 638 lb. empty. It is painted white both inside and externally above the equatorial plane and black below. An arm, 14 ft. long, extends horizontally from it carrying a fan on the end, which supplies a tangential force to rotate the whole balloon. The gondola is provided with an 80 ft. round point triangular parachute operated by a pilot parachute to draw it from its bag.

#### INSTRUMENTS AND EQUIPMENT

The bag is provided with a 3-ft. dial thermometer near the top to be viewed directly from the gondola through porthole and vent. For cosmic ray studies, Prof. R. A. Millikan has supplied three ionisation chambers, one exposed, one in two inches of lead and one, weighing 600 lb., in four inches of lead. Dr. W. F. G. Swann has supplied counter sets for various elevations from the horizontal, a lead-shielded chamber for 'bursts' and a Wilson expansion chamber. Mr.

O. H. Gish has supplied an apparatus consisting of a vertical chimney external to the gondola 1 ft. in diameter and 3 ft. high for a continuous ion count of the external air. Sun, sky and earth brightness records will be taken from outside the gondola, and records made of temperature and barometric pressure with resistance thermometer and short mercurial barometer respectively. The readings of the latter will be further checked by vertical camera studies of the ground and transit circle observations of the balloon made from the ground.

The sun and sky light will be studied spectrographically both from within and without the gondola for ozone content of the stratosphere. Mention has already been made of the vertical camera for height observations, but other cameras will photograph the horizon to obtain the figure of the earth, and a motion picture camera is provided to record any moving events. Air samples will be taken and spores collected, and even cultures of fruit flies are to be exposed to the rigours of the stratosphere. Finally, the observers will be in continuous radio communication with the ground on a transmission of 13,050 kilocycles per second, and a study will be attempted of the diffraction by the horizon of two sets of modulated waves emitted from the gondola aerial at 56,000 kilocycles and 112,000 kilocycles a second respectively.

### News and Views

#### Retirement of Sir George Adam Smith

WHEN the autumn term begins, the Very Rev. Sir George Adam Smith will retire from the principalship of the University of Aberdeen. His long service of twenty-six years as principal exceeds that of any of his predecessors since the present University arose from the union of "The King's College" and "The Earl Marischal's College" on the passing of the first Universities Act of 1858. He has watched and guided the University during a period of notable development, when a demand for specialisation has increased the teaching staff by the addition of nine professorial chairs, three readerships, and forty-seven lectureships; and when these changes, together with an increase in the number of students from 1,007 to 1,272, have required considerable additions to the fabric of the University itself. Of equal importance for the future of education and of scientific research has been the formation of linkages binding the University as a working unit with other institutions. In the present year the former United Free Church College in Aberdeen has joined with the University, and co-operation of great promise for the development of biological investigation in the north takes place with the Rowett Institute for

Research in Animal Nutrition, the Macaulay Institute for Soil Research, the Scientific Laboratory of the Fishery Board for Scotland, and the Torry Research Station. In the course of another year a new and vital link between the teaching and clinical aspects of medical subjects will be completed at the new Infirmary. These developments, on which, in some directions, the future of the University depends, Sir George has guided with a tact and balance of mind and with a friendliness and humanity which have endeared him to his fellow-workers in the University; and both town and University appreciate his services in ensuring that common appreciation, co-operation and goodwill unite the civic and academic interests of the community.

#### Valentin Magnan

THE eminent French psychiatrist, Valentin Jacques Joseph Magnan, the centenary of whose birth was celebrated on May 27 by a special meeting of the Société médico-psychologique, was born on March 16, 1835, at Perpignan, which was also the birthplace of three other celebrated French psychiatrists, Pinel, Esquirol and Falret. His medical education took place first at Lyons and then in Paris, where he

qualified in 1866 with a thesis on the anatomical lesions in general paralysis. The following year he was appointed physician to the Asile Sainte-Anne, to which he was attached for forty-five years. His most important work was concerned with the psychoses produced by alcoholism, in the modern investigation of which he was a pioneer, absinthe, in the prohibition of which in France he was mainly instrumental, and morphia; epilepsy, and sexual anomalies and aberrations. As director of Sainte-Anne, where he founded the Société clinique de médecine mentale, he was an enthusiastic advocate of the no restraint system and especially of the suppression of the straight-jacket. His clinical lectures, which attracted numerous French and foreign physicians to Sainte-Anne, were for thirty years published in *Le Progrès Médical*, of which the issue for June 8 commemorates the centenary. In 1893 he was elected a member of the French Academy of Medicine, of which he became president in 1915. In his will he left the sum of 25,000 francs to the Academy for the foundation of a prize in psychiatry which bears his name. His death took place on September 27, 1916, when he had reached the age of eighty-one years, his faculties remaining intact until the end.

#### Basutoland in Transition

FUNDAMENTAL changes in the life and economy of the natives of Basutoland are foreshadowed by the report (Cmd. 4907. H.M. Stationery Office) of the Commission, of which Sir Alan Pim is chairman, appointed by the Secretary of the Dominions to inquire into the financial and economic position of the country. The recommendations are drastic and affect almost every aspect of native life. The gravity of the financial situation, which dictated the appointment of the Committee in the first instance, shows no sign of alleviation, and even in the improbable contingency that the proposals are entirely set aside, the force of circumstances alone, it would seem, will bring about disastrous changes which will lead to the breakdown of native culture and the system of administration. The spirit of independence and pride of race characteristic of the Basuto people should be preserved at all costs as the essential condition of their future progress. Their spirit is explicitly recognised in the Report as a dominant factor in the problem of reform; but it is pointed out that, unless rightly directed, it may prove an obstacle in the way of advance towards the goal the Commission has in view—the creation of a real system of 'indirect rule'. In the multiplicity of topics discussed and of ameliorative measures suggested, this is the major issue. While the financial situation of the Protectorate has undoubtedly complicated its political future, the internal situation and the formulation of a settled administrative policy which will afford opportunity for the development and utilisation of the admittedly favourable traits in native character and culture must obviously be a prior consideration to that of the eventual transfer of responsibility to the Union of South Africa.

#### R.A.F. Big Flying Boat

THE performance figures of the *Saraband* built by Short Brothers of Rochester for the R.A.F., just divulged for the first time although the machine was built in 1932, show that it is by far the largest flying boat in the R.A.F. equipment, and is more powerful than even the German *D.O.X.* Its engines total 5,500 horse-power, maximum speed 150 miles an hour, climb 750 ft. a minute, with an air range of 1,450 miles, with full load. In this respect it is worth remembering that many countries make a practice of reporting performance trials with specially lightened loads. The machine has a wing span of 120 ft. and is 90 ft. long. It carries a military load of 5,960 lb., which includes an automatic pilot, the usual machine guns, and a 1½ in. automatic quick frer. The hull is a self-contained unit, containing sleeping accommodation for the crew, a workshop, a ward room, a drying compartment, an anchor winch, and gear for changing engines afloat. It is built entirely of steel and duralumin, and the hull design incorporates many novel structural features. A civil flying boat of the same size was under construction at the same time, but was stopped for reasons of economy.

#### Presentation of Prof. Piccard's Gondola to the Science Museum

ON June 12, the gondola of the balloon in which Prof. A. Piccard and M. Max Cosyns ascended into the stratosphere on August 18, 1932, was presented to the Science Museum, South Kensington, by M. Jean Willems, director of the Fonds National de la Recherche Scientifique, Brussels. His Excellency the Belgian Ambassador presided, and both Prof. Piccard and M. Cosyns were present. The gondola consists of an air-tight sphere (about 2 metres in diameter) of aluminium alloy, fitted with two man-holes and several portholes, and equipped with various scientific instruments; it was attached to the hydrogen-filled balloon with which Prof. Piccard made his previous ascent on May 27, 1931. The second ascent, in 1932, was made from Dübendorf Aerodrome, near Zurich, and after a twelve-hour flight, the balloon landed safely in a field at Cavallaro di Monzambano, about ten miles south of Lake Garda. The maximum height reached during the voyage (determined trigonometrically) was 16,940 metres (10½ miles). The main objective of the flight was the investigation of cosmic radiations. Observations were made to ascertain the variation of intensity of these rays with height, and the distribution of the radiation in different directions was studied by means of a tubular Geiger counter.

#### Early Design for an Aeroplane

THE Science Museum, South Kensington, has just acquired through the generosity of Mr. P. A. Smith of Scarborough a small disc of silver about an inch in diameter bearing an engraved design for a flying machine which is remarkable in conception. The disc bears the initials 'G.C.' with the letter 'R' beneath and it is dated 1799. The reverse contains a diagram of forces relative to the design illustrated.



There is little doubt that it is the work of Sir George Cayley, Bart. (1774-1857), who was the first to attempt to explain mathematically the fundamental principles of mechanical flight. The flying machine represented is a manually propelled (assisted) glider. It is a large monoplane, the plane being curved, with the operator sitting in a boat-shaped structure below and working by means of levers two large rectangular oars or paddles which were probably intended to function on the non-return valve principle by means of flaps. An interesting feature is the combined rudder and elevator arrangement which consists of surfaces fixed at right angles to one another, the whole, it appears, universally pivoted—a device which has been attributed to Alphonse Penaud at a much later date. Research is being undertaken to discover the full significance of the design, but the disc has been placed on exhibition.

#### The National Physical Laboratory

THE report of the Laboratory for the year 1934 is a well-illustrated and indexed quarto volume of 260 pages. Each of the eight departments of the Laboratory gives a short account of its principal activities in an interesting and thoroughly readable form. The increase in activity in industry has produced a corresponding increase in the work carried out by the Laboratory, particularly in that relating to ship-building, and it has been necessary to call for overtime and to increase the staff. The movement for the abatement of noise has resulted in demands on the Sound Department from the Ministries of Health and of Transport. The deaths of Sir Arthur Schuster, Sir Horace Lamb, Sir Alfred Ewing and Dr. W. Rosenhain have deprived the Laboratory of four of its friends and supporters, but the changes of staff have been slight. The lectures on the work of the Laboratory given at a number of provincial centres have been much appreciated, and are to be continued. The new buildings for photometry will probably be brought into use this year, new high-speed wind tunnels are already in operation and the Lithgow installation for testing propeller blades will be available next year. The comparison of standards of measurement of all kinds with those of other countries has been continued with satisfactory results. The sound-isolating properties of walls and partitions of many types have been investigated and field tests of actual buildings can now be carried out. The work on refrigeration and preservation of food of all kinds has been continued for the Food Investigation Board, and that on protection from and dosage of X-rays and radium, for the Medical Research Council. The lubricating value of the oils derived from the distillation of coal is being investigated, and the production and working of the extremely light alloys of magnesium are being tested. Rapid advances are being made in our knowledge of the structure of the ionosphere, on which so many of the phenomena of wireless communication depend.

#### The Grand Coulee Dam

THE Columbia River in the United States is second in size only to the Mississippi. Owing to

the fact that its source is high in a region of melting snows in the mountains of western Canada and Montana, its discharge is more continuous than that of all the arid regions of the west and the middle west combined. In an article in the *Scientific American* of April, Grace Kirkpatrick gives an interesting account of the Grand Coulee (Grand Valley) dam which engineers are now busily constructing. In prehistoric times the Columbia River, then much larger than it is to-day, was dammed by a glacier, and the torrents of water which poured through the high cliffs bordering the river flowed down and formed the Grand Coulee. The walls of the valley are in some places 1,000 feet high. The upper 20 miles of the river are being closed with dams at each end to form a huge reservoir. The Columbia River sweeps across the State of Washington and forms for many miles the border between Washington and Oregon. On the plateau above its canyon-like banks are millions of arid acres known as the Columbia Basin which if suitably irrigated would be one of the most fertile lands in the world. The dam is being built in two units—the high dam and the low dam. The latter is exclusively a power development while the high dam will be used for power, irrigation, storage and navigation development. The dam will raise the waters of the Columbia so that they can be pumped into the reservoir of the Grand Coulee and will then flow over the parcelled acres of the Columbia Basin. The blocking of the river will create the largest artificial lake in the world. It is 151 miles long and will extend into Canada. The spillway in the centre of the high dam will be 1,800 feet long and no less than 325 feet high.

#### Costs of Electric Lighting since 1910

THE lowering of the cost of the electric light during the last twenty-five years, mainly due to scientific research and improved engineering methods, is fully appreciated by few. In 1910, carbon filament lamps, which had held the foremost place since the inception of the incandescent lamp, were rapidly being replaced by tantalum and tungsten lamps giving almost twice as much light for the same electric power. In the same year, by means of the new 'squirted' filament lamp, the light-giving efficiency was more than doubled. In 1912 the drawn tungsten filament nearly trebled the efficiency. All these lamps were vacuum lamps. In 1916 the invention of the gas-filled lamp trebled the efficiency, and the latest type of gas-filled lamp, the 'coiled coil' lamp, has nearly quadrupled the light efficiency, giving 11.25 lumens (approximately 0.9 candle) per watt. Many consumers are now getting their electric light at a cost of 0.5d. per unit who had to pay 6d. or more per unit in 1910. Electrical engineers and scientific workers may well be proud of lowering the cost to one fiftieth of what it was in 1910.

#### Metallurgical Research

THE lecture given by Dr. H. Moore, director of the British Non-Ferrous Metals Research Association, before the London Section of the Institute of Metals

on November 8, 1934, published in the March issue of the Institute's *Journal*, constituted an extremely valuable review of the more immediate past and future of metallurgical development. Under the title of "Recent Trends and Future Developments in Metallurgical Research", Dr. Moore surveyed the application of physical and physico-chemical methods to the study of metals and alloys, with particular reference to the industrial application of the results of research. In the period under review—the past decade—the output of metallurgical research has undoubtedly been unparalleled; but in Dr. Moore's view the main bulk of this large output has been concerned with the exploitation of fundamental concepts which had been developed more than ten years ago. Research in progress at the present time is reviewed under six main heads: melting and solidification, working of metals, heat treatment, mechanical properties, corrosion, and electro-deposition, and the directions in which work may be expected to proceed in the near future are outlined. The impression gained from this exceptionally interesting and virile address is one of boundless fields of research, offering fascinating possibilities in the extension of the use of metals for a very wide range of purposes for the benefit of civilisation.

#### Science and Humanism

In the quest for a unity underlying the rich variety of the universe, philosophers are in constant danger of limiting themselves to unreal abstractions and verbal dialectic. Both those who call themselves pragmatists, as dealing with things rather than with words, and those who prefer the fuller name of humanists, find that science, the most objective of human experiences, has a large contribution to make to our general body of thought. As is pointed out by A. Rey in "Les Mathématiques en Grèce" (*Actualités Scientifiques*, 217. Paris: Hermann et Cie., 1935) the study of the history of science may be recommended on two grounds. It may make scientific thought more accessible to philosophers, and may do something to break down, among scientific workers themselves, that narrow specialisation which is so prevalent to-day. Among the ancient Greeks, as also in the Renaissance, both ages of humanism and free inquiry, science had a considerable place, though not an exclusive one. The humanism of to-day has at its disposal an embarrassing array of tempting dishes; the difficulty is to make a well-balanced selection from them, and to get the whole range of mental vitamins without suffering from hyper-vitaminosis.

#### Description and Identification of Species

In spite of the three quarters of a million species of animals which have been described binomially, it is remarkable how little there is of organised plan in the descriptions, taken as a whole. Some authors of new species are content with a few lines of characterisation, others seem to describe, not a species, but the total characters of an individual specimen. It is partly that species are not fixed, and that few

writers, even on the same group, would agree upon the characters to be selected as criteria of specific rank, partly that the critical characters within different groups appear to be so diverse, that no common plan would fit more than a relatively few. Dr. Séverin Icard has made a bold attempt to standardise descriptions of species by advocating a method which he calls "la méthode des nombres signalétiques" (*Revue de Path. comp. Hyg. gen.*, Nov. 1934). It looks quite simple. Shortly, it is that, in regular order, parts of the specimen to be identified or described are examined, and the result for each part is represented by a number. The key to the parts to be examined for a particular group, and to the number corresponding to a particular character, say, legs yellow, is to be found in a set of "Tables de correspondance". Thus the special character of each part has its own particular number, a short-hand way of writing a description which normally would contain at least a few words for each part.

#### Species Formula

In describing a beetle, for example, Dr. Icard chooses seven characters, always read in the same order—colour of thorax, colour of elytra, form of thorax, form of elytra, form of feet and tarsi, form of antennæ, form of head. Each character, in a particular specimen, is represented by a number—the *nombre signalétique* or descriptive number, so that the total description of the specimen as regards specific characters may be represented by a series of numbers—the *formule signalétique* or specific formula. We wish to identify a beetle; we translate one by one its characters into the appropriate number; then having composed our specific formula we search for this particular formula in another book of words, "Le Répertoire général", and if we find the formula there we shall also find opposite it the name of the species which possesses this characteristic association of characters. It is an attractive idea that the plant and animal worlds should be so completely tabulated that a set of symbols would identify any of their members, and if the method would enforce upon describers of species definiteness in characterisation and brevity, it might be well worth a trial.

#### Suggested Biological Survey for Union of South Africa

In the *South African Journal of Science* (Nov. 1934, p. 396), Dr. R. Bigalke makes a plea for the inauguration of a biological survey in the Union. During 1911–33 the Provinces spent £607,674 in connexion with fish and game preservation and the destruction of vermin, and the suggestion is that a biological survey would furnish scientific information for the more efficient use of such expenditure. The survey would be a unit of the Department of Agriculture, and it would set in the forefront of its aims the solution of pressing economic problems, such as the biology and control of predatory animals, of noxious rodents, or rabies transmitters, and the relation of wild birds to agriculture. Before such

investigations had progressed far, the need for faunistic surveys would become obvious, and for the prosecution of these co-operation would be sought with the various museums. The author estimates that such a survey could be set going with a staff of not less than six biologists, who should have taken zoology as a major subject and botany and geology as minors. But can any thorough study of fauna be carried out without recourse to fairly thorough statistical analysis, and the author says nothing about mathematical qualifications.

#### The Men of the Trees

THE tenth annual report of the Society of the Men of the Trees reviews the work of the past year, which has shown an increased membership of the Society, inaugurated by Mr. St. Barbe Baker. The work of the year has included lectures, meetings and exhibitions. Of the latter, the chief was the International Picture Exhibition, held at Grosvenor House, Park Lane, London, throughout November. Thirty-seven countries assisted the exhibition by sending tree paintings by some of their foremost living artists, and also treasures from the national collections. Several addresses were delivered at meetings by Ambassadors and Ministers accredited to Great Britain. The opening address was given by Field Marshal Viscount Allenby, who dwelt upon the importance of forestry and tree-planting in Great Britain to make good the wastage of the late War. Lord Allenby, even before the War was over in Palestine, had started to restore the land by tree-planting, a commencement which inspired the Men of the Trees to carry on the work. Before opening the exhibition, Lady Georgiana Mure pointed out that forestry and the care of trees is a world-wide thing and that we can "meet our friends from Overseas on a common ground of good fellowship, occasioned by the mutual admiration and love of the countryside and its chief ornament, trees". Mr. Baker directed attention to the advantage from an æsthetic point of view, as well as the hygienic and economic, of planting up the slagheaps in the Black Country of England, and stated that a part of the proceeds from the exhibition was to be devoted to that object.

#### Cereal Synonyms

THE Cereal Synonym Committee has come to a number of decisions on the stocks of cereals which it examined in 1934. In arriving at these decisions, the Committee was guided by the following definition of a cereal synonym: "The Cereal Synonym Committee regard two cereals as synonyms when they present precisely similar morphological characters, and when they also possess identical physiological characters in so far as they can be determined. Even then by this term they do not necessarily imply that these two varieties are of identical origin, though doubtless in the majority of cases they are. The possibility of two cereals of different parentage presenting such a close, if not complete similarity as to mask their individuality has not been lost sight of.

But the Committee have to deal with facts as they are; they, therefore, regard as synonyms all cereals which are identical in the sense used above even when they know that the origins are different. Before the Committee come to a conclusion concerning the synonymy of any variety the breeder and/or the introducer is given an opportunity of demonstrating to the Committee such differences as he may claim to exist between his variety and the type variety." In compliance with the request of the Committee that as much publicity as possible should be given to its decisions, the National Institute of Agricultural Botany, Cambridge, has published a leaflet giving full details of the findings for the wheat, oats and barley varieties investigated.

#### Review of Agricultural Research

THE Royal Agricultural Society of England has recently issued its *Journal* for 1934, vol. 95. As last year, "The Farmer's Guide to Agricultural Research" has been incorporated with the annual publication, so that it may be available to every member of the Society. At the same time a number of copies are being bound separately for distribution to the Press and to centres of agricultural education and research. This valuable survey of recent scientific work has been carried out on the same lines as in previous years and the authors responsible for the various sections, namely, crops and plant breeding, diseases of animals, farm implements and machinery, farm economics, dairy farming and dairy work, the feeding of livestock, and soils and fertilisers, are the same as in 1932. The work dealt with is not limited to research conducted in the British Isles, but includes references to results achieved in any part of the world from which light may be thrown on the problems of British agriculture. A few copies of previous issues (1925-32) are still available.

#### British Standard Specifications for Laboratory Glassware

IN further development of the work which is now being carried out by a committee of the Chemical Division of the British Standards Institution in the standardisation of laboratory ware including scientific glassware, British standard specifications have just been issued for graduated measuring cylinders, Crow receivers, Nessler cylinders and Petri dishes. Copies of the specifications (Nos. 604, 605, 612 and 611-1935 respectively) may be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 2d. each post paid.

#### New Museum of Practical Geology, South Kensington

THE opening of the new Museum of Practical Geology, South Kensington, London, S.W.7, and the celebrations of the centenary of the Geological Survey of Great Britain, will take place on July 3-4. The opening ceremony will be performed by H.R.H. the Duke of York on July 3 at 3 p.m. A preliminary account of the proceedings appeared in *NATURE* of March 23, p. 463. In the final programme now issued, it is announced that the director of the

Geological Survey, Sir John Flett, will deliver an address on July 4 on the history and functions of the Museum, in the lecture hall of the Victoria and Albert Museum. Several geological excursions have been arranged to follow the celebrations, and delegates will have the opportunity of studying, under expert guidance, the Isle of Wight and mainland opposite, the Wealden district, South Wales and Bristol, or Edinburgh and surrounding country. Further information can be obtained from the Director, Geological Survey of Great Britain, Museum of Practical Geology, South Kensington, London, S.W.7.

#### Announcements

WE regret to announce the death, which occurred on June 14, at the age of seventy-six years, of Prof. J. B. Cohen, F.R.S., emeritus professor of organic chemistry in the University of Leeds.

THE following awards of the Royal Aeronautical Society have recently been made: *Society's Silver Medal*, Mr. C. C. Walker and Major F. B. Halford; *Simms Gold Medal*, Dr. L. Aitchison; *Taylor Gold Medal*, Mr. F. Rodwell Banks; *Busk Memorial Prize*, Dr. H. Roxbee Cox.

THE Trustees of the Lady Tata Memorial Fund announce that, on the recommendation of the Scientific Advisory Committee, they have made the following awards of scholarships and grants for the academic year 1935-36. These awards were open to suitably qualified persons of any nationality, for research work in diseases of the blood, with special reference to leukaemia. *Scholarships*: Dr. M. C. G. Israëls (Manchester), Dr. O. Kaalund-Jørgensen (Aarhus). *Grants*: Prof. W. Büngeler (Danzig), Dr. J. Engelbreth-Holm (Copenhagen), Dr. Karl Hinsberg (Berlin), Dr. Ch. Oberling (Paris), Prof. Eugene Opie (New York), Dr. Lucy Wills (London).

A CONFERENCE on some aspects of the metallic state will be held in the H. H. Wills Physical Laboratory, University of Bristol, on July 2-5. One of the University halls of residence will be available for those attending the conference, and anyone wishing to have accommodation reserved there is requested to communicate with Prof. N. F. Mott, H. H. Wills Physical Laboratory, The University, Royal Fort, Bristol, 8.

IN connexion with the Noise Abatement Exhibition at the Science Museum, South Kensington, a conference at the Museum on June 26-28 has been arranged by the Anti-Noise League, 66 Victoria Street, S.W.1. The programme includes discussions on "Sound and Noise", to be opened by Dr. G. W. C. Kaye, of the National Physical Laboratory; on legal and housing aspects of noise; on the noise problem in relation to education; and on "Health and Noise", to be opened by Lord Horder.

It has recently been decided by the Italian Ministerial Council that the participation of Italians

in International Congresses should depend on Italian being made one of the official languages.

WE have received the commemorative number of the *Colliery Guardian and Journal of the Coal and Iron Trades*, which celebrates the 150th volume of that paper; as there are two volumes a year, this means that this paper has been issued for seventy-five years, no mean achievement for a technical paper. The paper commences with a review of British coal mining during this period and with a brief account of the history of the journal since its formation. This is followed by a series of articles by various men well known in the colliery world for their eminence in the subjects which they have selected.

A PROSPECTUS has been circulated of the publication by Messrs. McFarlane, Warde, McFarlane, of New York, of the illustrations of the "Anatomy of the Human Body", by Andreas Vesalius (1514-64). The drawings for this great work were made by John Stephen of Calcar in Cleves, a pupil of Titian. The book, a double crown folio (15 in. x 21½ in.), will contain all the illustrations of the "Fabrica" and "Epitome"; 228 plates have been printed from the original blocks, 227 of which have been preserved in the University of Munich, with the descriptive Latin text. The work is edited by Drs. Lambert and Malloch of New York, and Willy Wiegand of the Bremer Press, Munich. The subscription price is 100 dollars.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Mechanical and Civil Engineering Department in the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland (June 25). A district forest officer, and a district estate officer in the Forestry Commission—The Secretary, 9 Savile Row, London, W.1 (June 25). A lecturer in rural science and gardening in Bangor Normal College—The Registrar (June 26). A lecturer in mathematics and electrical transmission and distribution of power in the Derby Technical College, Green Lane, Derby—The Clerk to the Governors (June 29). A lecturer in engineering in Loughborough College—The Registrar (June 30). A lecturer in organic chemistry in University College, Exeter—The Registrar (July 1). A lecturer in agriculture and farm director in the Midland Agricultural College, Sutton Bonington, Loughborough—The Principal (July 2). A lecturer in agricultural chemistry and physics in the Swanley Horticultural College for Women, Swanley, Kent—The Principal (July 8). A professor of mining in the University of Leeds—The Registrar (July 8). An assistant in the Admiralty Technical Pool (electrical engineering)—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (July 13). A botanist at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7. A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

## 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. 1042.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## What is a Colloid?

ASSOCIATION is the characteristic factor in the colloidal state.

Without it, no films, fibres, glasses, resins or plastics, no jellies, gels, liquid crystals, coagula or gelatinous precipitates, no high viscosity (Graham's colloidoscope), no opalescence, no colloidal particles built up of a myriad of ordinary atoms or molecules, no electrosmosis or streaming potential, no membrane equilibrium or any of the effects defined by Loeb as 'colloidal behaviour', no stabilising agents or protective action or sensitisation, no stability however transient of the great majority of colloidal particles which are dependent upon structural arrangement, not even the folding of the long chain molecules that gives the characteristic properties to such colloids as wool or rubber; none of the beautiful and varied architecture which utilises as building stones the colloidal particles, which are themselves products of association.

In recent years there has been a tendency, particularly on the part of some who have been emphasising the immensely long chain structure of certain natural and synthetic colloids and their relation to viscosity in very dilute solution, to do away with the term micelle and to think only of the individual molecule as a single simple kinetic unit. However, since the convincing work of Sponsler, Dole, Meyer, Mark and Staudinger, no one now questions the long chain nature of such molecules as cellulose.

Soaps are still recognised as association colloids, and the association of their molecules and ions is known to produce particles of orderly structure. Yet this distinction is incompletely valid, for in dilute solution, to which Staudinger's formulations are confined, soaps are not colloids at all. As a matter of principle, in sufficient dilution in a suitable medium, all colloids are resolved into their molecular or ionic constituents, as happens with sols of  $WO_3$  and  $V_2O_5$ . Few would care to deny association in higher concentrations, but are we to assume that in contrast to soaps or suspensions the association of long chain molecules is wholly disordered?

Whereas in dilute solution simple sulphonic acids, as will be shown in a series of articles elsewhere, consist of ordinary molecules and ions, in concentrations above  $N/10$  association is so predominant as wholly to submerge the influences discussed in the interionic attraction theory. The result is that effects such as conductivity, freezing point lowering, and electromotive force increase instead of decreasing with concentration. Association must be of the cohesive van der Waals' type, emphasising the principle of 'like to like'.

When association is so predominant in such simple cases, it must be important in the behaviour of chain molecules, and indeed must be a factor always to be reckoned with in all solutions.

JAMES W. MCBAIN.

Stanford University,  
California. May 22.

## Raman Spectra of Deuterobenzenes and the Structure of Benzene

THE letter by Klit and Langseth in NATURE of June 8 (p. 956), recording Raman frequencies of some deuterobenzenes, leads us to report our own results so far as these overlap, although we had wished to reserve publication until the problem of which these spectra supply only part of the answer had been fully solved. Klit and Langseth record 8 lines for  $C_6D_6$ , and 1 for each of  $C_6H_5D$  and  $C_6HD_5$  (not obtained pure). This note relates to  $C_6D_6$  and  $C_6H_5D$  (both pure); we have not prepared  $C_6HD_5$ ; we have, however, examined 1:4- $C_6H_4D_2$  and hope to study 1:3:5- $C_6H_3D_3$  also, for the following reason.

An acute problem concerning the structure of benzene was raised when Placzek showed<sup>1</sup> that the same fundamental frequencies cannot appear in both the Raman and infra-red spectra of molecules possessing a centre of symmetry. Bhagavantam<sup>2</sup> and Krishnamurti<sup>3</sup> had directed attention to several apparently coincident frequencies in these two spectra for benzene, and this seemed to show that benzene has not the plane regular hexagonal structure (point group  $D_{6h}$ ) which the resonance theory requires. Various models of lower symmetry have been suggested by Placzek himself, and by Cabannes and Rousset<sup>4</sup>, Deitz and Andrews<sup>5</sup>, Weiler<sup>6</sup> and others. One model of sufficient dissymmetry is the static Kékulé structure, but to revert to this would be retrograde on other grounds. The difficulty would disappear, however, if it could be shown that the coincidences are accidental, that is, that the identical or nearly identical frequencies depend in fact on different proper vibrations. The problem is therefore to identify the proper vibrations, and this we shall do by measurement of the H-D displacements, first when the total symmetry of benzene is maintained as in  $C_6D_6$ , and secondly when different elements of symmetry are removed, as in 1:3:5- $C_6H_3D_3$ , 1:4- $C_6H_4D_2$  and  $C_6H_5D$ . At present we are studying the Raman, infra-red and ultra-violet spectra of  $C_6D_6$ , 1:4- $C_6H_4D_2$  and  $C_6H_5D$ .

	$C_6H_6$		$C_6D_6$		$C_6H_5D$	
	Literature	This Note	K. and L.	This Note	K. and L.	
(i)	607 (3)	583 (3)	582	609 (3) 785 (1)	—	—
(ii)	849 (1)	666 (3)	845	855 (1)	—	—
(iii)	993 (10)	944 (10)	947	984 (10)	982	—
(iv)	1176 (3)	867 (3b)	870	1175 (5)	—	—
(v)	{ 1585 (3b) 1606 (1)	{ 1536 (3b) 1566 (3b)	{ 1555 1569	1597 (5b)	—	—
(vi)	3049 (2)	2265 (3)	2267	{ 2271 (2)	—	—
(vii)	3064 (5)	2292 (5)	2292	{ 3059 (10b)	—	—

Our Raman frequencies for  $C_6D_6$  and  $C_6H_5D$  are in the accompanying table; approximate intensities are given in parenthesis, but not polarisations, as these measurements are not yet complete. The

$C_6D_6$ , m.p.  $6.8^\circ$ , was prepared by our sulphuric acid method<sup>7</sup>, and the  $C_6H_5D$ , m.p.  $5.5^\circ$ , by the Grignard reaction. Klit and Langseth's frequencies (they do not record intensities) are added for comparison. The agreement is satisfactory, except for line (ii), which they find undisplaced in  $C_6D_6$ , whereas we observe a very striking shift. The self-consistent allocation of frequencies suggested below would have been impossible without this result. Frequencies are in  $cm^{-1}$ .

No scheme of identification can be regarded as final which is based on only part of the evidence, but it is of interest that our  $C_6D_6$  frequencies permit an allocation consistent with the symmetry  $D_{6h}$ . The proper vibrations of this benzene model have been formulated by E. B. Wilson<sup>8</sup>, and Dr. E. Teller has given us the results of an equivalent calculation and of an unpublished theorem leading to frequency relations by means of which any assumed model may be tested. This theorem relates to the product,  $\Pi_N \nu$ , of the frequencies,  $\nu$ , of any complete set of proper vibrations of like symmetry,  $N$ ; it gives, indeed, the quotient,  $\tau_N^2 = (\Pi_N \nu)_1 / (\Pi_N \nu)_2$ , for any two compounds 1 and 2, which differ only isotopically with respect to one or more of their atoms.

The  $D_{6h}$  benzene model requires seven Raman fundamentals, divisible into three symmetry classes having distinctive relations between the tensor components,  $c_{ik}$ , of the change of polarisability (6-fold axis =  $z$ ). Class  $A'$  ( $c_{xx} = c_{yy}$ ,  $c_{ik} = 0$ ) contains two totally symmetrical ('breathing') frequencies, one involving mainly C-H stretching, and the other C-C stretching. Class  $C''$  ( $c_{ii} = c_{xy} = 0$ ) has one degenerate vibration corresponding to C-H bending perpendicular to the ring. Class  $D'$  ( $c_{xx} = -c_{yy}$ ,  $c_{zi} = 0$ ) comprises four degenerate frequencies, one dependent mainly on C-H stretching, one on C-H bending, and two on ring deformation, all in the plane of the ring. Applied to  $C_6H_6$  and  $C_6D_6$ , Teller's theorem gives  $\tau_{A'}^{H,D} = 1.41$ ,  $\tau_{C''}^{H,D} = 1.29$ ,  $\tau_{D'}^{H,D} = 2.00$  (using distances C-C, 1.42, and C-H, 1.10 A.).

of the doublet). Within classes  $A'$  and  $D'$  the separate approximate vibrations are allocated by means of the frequencies and the frequency shifts.

W. R. ANGUS. A. H. LECKIE.  
C. R. BAILEY. C. G. RAISIN.  
J. L. GLEAVE. C. L. WILSON.  
C. K. INGOLD.

University College,  
London.  
June 8.

<sup>1</sup> Leipziger Vorträge, 1931, p. 100, *et. seq.*

<sup>2</sup> *Indian J. Phys.*, 5, 615; 1930.

<sup>3</sup> *ibid.*, 6, 543; 1932.

<sup>4</sup> *Ann. Phys.*, 19, 229; 1933.

<sup>5</sup> *J. Chem. Phys.*, 1, 62; 1933.

<sup>6</sup> *Z. Phys.*, 85, 58; 1934.

<sup>7</sup> *NATURE*, 134, 734; 1934.

<sup>8</sup> *Phys. Rev.*, 45, 706; 1934.

<sup>9</sup> *ibid.*, 46, 146; 1934.

### A New Nitrogen Afterglow Spectrum

IN a communication in these columns<sup>1</sup> I directed attention to the presence of two members of the Vegard-Kaplan system of nitrogen in the spectrum of the afterglow that was discovered by me in 1934<sup>2</sup>. Although very weak, the presence of these bands was the first direct proof of the existence of metastable molecules in active nitrogen. The spectrum of this afterglow was a very faithful reproduction of the auroral spectrum.

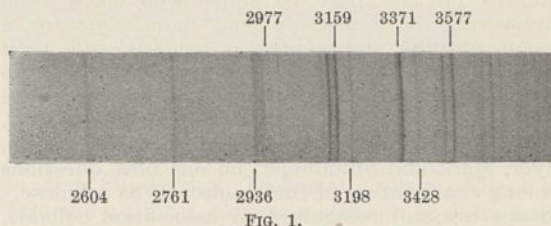


FIG. 1.

I have recently photographed the spectrum of the afterglow which is produced when the current is greatly diminished relative to that which produces the auroral afterglow. In fact, the current was so small that the discharge in the tube was barely visible. The spectrum of this afterglow is shown in Fig. 1, and it differs from the 1934 afterglow in the absence of the first-negative bands of  $N_2^+$  and in the great enhancement of the relative intensity of the Vegard-Kaplan bands. The wave-lengths of some of the members of this system are marked on the bottom of the figure and those of the second-positive system on the top. When it is recalled that the Vegard-Kaplan system is emitted by the  $A^3\Sigma$  metastable molecule, the remarkable nature of this spectrum is realised. The intensity of this system relative to the second-positive bands is much greater in this afterglow than in any other source so far observed, afterglow or discharge.

Several times recently I have offered the hypothesis that some of the radiations from the night sky agree closely with observed and predicted Vegard-Kaplan bands. The discovery of this new afterglow spectrum greatly favours that hypothesis. Also in its support is the great increase in relative intensity of the green auroral line when the current in the rapidly interrupted discharge is made equal to the one that produces this new afterglow. The relative intensity of the green line is increased at least by a

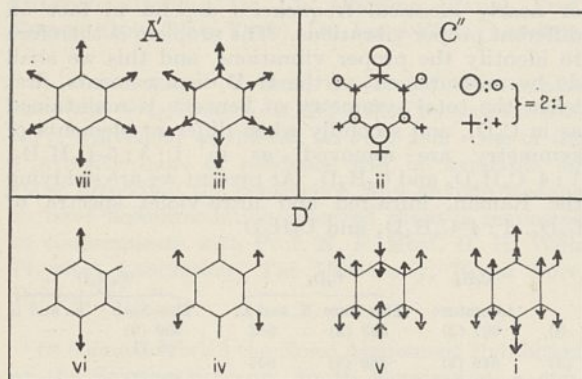


FIG. 1.

G. Placzek recognised the strong line (iii) as the C-ring 'breathing' vibration, and E. B. Wilson has suggested<sup>9</sup> that the doublet (v) arises from the accidental degeneracy of a fundamental with a combination tone. Our allocation is shown in the approximate graphical representation (Fig. 1). The symmetry classes are  $A' = iii + vii$ ,  $C'' = ii$  and  $D' = i + iv + v + vi$ , which gives  $\tau_{A'}^{H,D} = 1.41$ ,  $\tau_{C''}^{H,D} = 1.28$ ,  $\tau_{D'}^{H,D} = 1.96$  (using the mean frequency

factor of ten over that reported by me<sup>3</sup> recently in these columns. It is suspected that most of the green line radiation in rapidly interrupted discharges arises in the afterglow, and further experiments are in progress in order to verify this fact.

JOSEPH KAPLAN.

University of California  
at Los Angeles.

<sup>1</sup> NATURE, 134, 289; 1934.  
<sup>2</sup> Phys. Rev., 45, 671; 1934.  
<sup>3</sup> NATURE, 135, 229, Feb. 9, 1935.

### Electronic Charge from de Broglie Wave-lengths of Electrons

WORK has been going on for some years at Uppsala for the purpose of increasing the accuracy of the determination of electron wave-lengths. A high-tension set has been arranged, with a special electron valve smoothing circuit taking up changes in input and output, and a tension regulating device including a standard cell, so as to give high tension accurately known and steady within 0.01 per cent. Cathode rays from a hot filament, accelerated by this tension ( $V = 15-30$  kv.) and passing through two narrow slits are diffracted by an etched galena crystal, giving rise to cross-grating diffraction patterns<sup>1</sup>. With this arrangement one gets very sharp spectral lines of different orders. The angles of diffraction can therefore be measured with great accuracy. From these data one can calculate the wave-lengths of the cathode rays with an error less than 0.1 per cent, the grating constant of galena being well known<sup>2</sup>.

Using such wave-length values, one can make interesting calculations of several atomic constants. If, for example, we combine de Broglie's equation,

$$\lambda \sqrt{1 + \frac{eV}{2m_0c^2}} = \frac{h}{\sqrt{2em_0V}} = \lambda',$$

with the expression for the Rydberg constant,

$$R = \frac{2\pi^2e^4m_0}{ch^3},$$

we obtain for the calculation of the electronic charge

$$e = \text{const.} \frac{V^{3/4} \lambda'^{3/2}}{\sqrt[4]{e/m_0}}.$$

$R$  is known from spectroscopic measurements with very great accuracy, and  $e/m_0$  is fairly well known and enters the formula in the power 1/4. Thus, we can hope to find  $e$  with an accuracy sufficient to enable us to choose between oil drop and X-ray values of  $e$ .

Preliminary measurements give  $e = (4.796 \pm 0.010) \times 10^{-10}$  E.S.U.

The work is proceeding and a definite and detailed report will shortly be published elsewhere.

S. v. FRIESEN.

Physics Laboratory,  
University, Uppsala.  
May 22.

<sup>1</sup> S. v. Friesen, *Arkiv f. Mat. Astr. o. Fys.*, 24B, No. 8; 1934.  
<sup>2</sup> E. v. Zeipel, *ibid.*, 25A, No. 8; 1935.

### A Search for the Extreme Infra-Red Spectrum of the Sun

THE solar spectrum in the infra-red has been thoroughly investigated throughout the range of wave-lengths up to about 11  $\mu$ . Radiation of longer wave-length is practically completely absorbed, chiefly by the water vapour present in the atmosphere. According to E. von Bahr<sup>1</sup>, there are reasons to expect, from theoretical considerations, that for wave-lengths greater than ca. 400  $\mu$ , water vapour will be again transparent. In 1914 Rubens and Schwarzschild<sup>2</sup> made an attempt at the Astrophysical Observatory at Potsdam to measure the intensity of solar radiation in this region of the spectrum by using the quartz lens method for isolating it, but the intensity proved too small to be detected even by means of the very sensitive instrument they used.

On the suggestion of Prof. M. A. Lewitsky, we made a similar attempt last summer in the exceptionally clear atmosphere of the southern slopes of Mount Elbruz (Caucasus) at an altitude of 3,000 m. above sea-level. For isolating the extreme infra-red radiation, we used two sheets of black paper placed in front of a metal mirror 60 cm. in diameter; this focused the radiation transmitted through the paper on to one group of junctions of a differential surface thermopile, which was used in order to minimise the otherwise very considerable influence of stray radiation and changes of temperature. The thermocurrent was measured by means of a photo-relay similar in design to that described by Bergmann<sup>3</sup>. For illuminating the differential photo-cell of this relay we used a heliostat.

The apparatus proved so sensitive as to enable us to record one tenth of the radiation that was to be expected according to Planck's law for the region beyond 400  $\mu$ ; that is, the only region of wave-lengths likely to pass through the water vapour of atmosphere, two sheets of black paper and a quartz window, 2 mm. in thickness, of the thermopile.

Since the layer of the atmosphere below 3,000 m. holds about five-sixths of the total amount of water vapour contained in the atmosphere, we may take it that, so far as the absorption of the sun's rays by water vapour is concerned, the conditions of our experiment were about five times as favourable as those of Rubens and Schwarzschild, who worked at low altitude and in a contaminated atmosphere. On the other hand, the sensitivity of their apparatus was about twice as great as that possible with our apparatus in the open air. Although we had thus, on the whole, somewhat better conditions than they, we also were unable to detect any trace of radiation from the sun in the extreme infra-red.

A detailed description of our experiment will be published elsewhere.

V. G. VAFIADI.  
S. S. KRIVICH.  
G. V. POKROVSKY.

Optical Institute,  
Leningrad.

<sup>1</sup> E. von Bahr, *Verh. Deutsch. Phys. Ges.*, 710; 1913.  
<sup>2</sup> Rubens und Schwarzschild, *Sitzungsberichte Preuss. Akad. Wissensch.*, 702; 1914.  
<sup>3</sup> L. Bergmann, *Phys. Z.*, 32, 688; 1931.

### Philosophy and Modern Science

It is disconcerting to find how rarely physical scientists trouble to make themselves familiar with the results of recent psychological investigation, even those results of the more important and far-reaching

kind. While the psychologist is well-nigh constrained to follow, in a general way at least, the progress of physical inquiry, the physicist, when he ventures into the psychological field, almost invariably has recourse to a number of obsolete ideas, ideas which have long since been discarded by psychologists themselves.

What, for example, does Dr. Jeffreys mean by the term "sensation", which he uses so freely in his letter under the above heading in *NATURE* of June 1? Does he mean the mental act or process of *sensing* (more properly, the mental act or process of perceiving); or does he mean *that which is sensed* (or perceived), what it is now usual to call the *sensum*? If he means the former, then certainly "each sensation is private to one individual"; but, in that case, "we cannot," as Dr. Dingle says, "speak of observing sensations", not at all events in the way Dr. Jeffreys implies, because, as Dr. Dingle puts it, the "sensation" is the observing and "not a thing to be observed". If Dr. Jeffreys means the latter, then no doubt a sensation can be observed; but, in that case, it is sheer dogmatism to assert that sensations "obviously do not exist when they are not observed". That is by no means obvious; on the contrary, I imagine most modern psychologists would agree with Stout that sense-qualities, such as colours and sounds, "do essentially enter into the constitution of the material world". It requires, indeed, but little reflexion to see that what Dr. Dingle calls a "sensation of whiteness" (that is to say, the awareness of whiteness) is not itself white, any more than the apprehension of a triangle is itself triangular.

There is corresponding confusion in the use of the term "concept". It is, of course, impossible here to discuss in detail the nature of concepts; but briefly a concept may, psychologically considered, be said to be a way in which universals are cognised. Clearly, however, neither a ghost nor the planet Neptune (referred to in the correspondence in question) can be said to be either a universal or a concept; each is no less individual and particular than a patch of blue or a sound. Nor is it in the least degree true to say that what are sensations to one person are concepts to another person. I take it that by "concepts" the writer means, in this context, what are usually called "images"; and that he intends to assert that what one person is sensing another person can only imagine. Even that, however, is far from obvious, and cannot be laid down as an indisputable truth.

G. DAWES HICKS.

9, Cranmer Road,  
Cambridge.  
June 4.

OTHERS beside Prof. Dingle find this discussion "amusing"<sup>1</sup>. Each disputant is trying to show that only his philosophy is compatible with science; if he succeeded, he would surely destroy the object of his attempt. For the distinctive feature of scientific propositions, and presumably the source of their evidential value, is that they can be believed by anyone, whatever his philosophy.

Of course, this agreement may be illusory. Profs. Dingle and Levy, who have such strong and such divergent views about the "external world", may be assenting to entirely different propositions when they both assent to (say) Ohm's law. But then there is no science for them to quarrel about. If they are assenting to the same proposition, surely their first step should be to find out what this proposition is.

Of course, they will never agree as to why they agree; but they might agree as to what they are agreeing about. They will never achieve even that, while they insist in dragging in conceptions, such as reality and existence, that lie at the very core of their differences.

NORMAN R. CAMPBELL.

June 3.

<sup>1</sup> *NATURE*, 135, 912, June 1, 1935.

It does not seem to have occurred to the parties to this controversy that it is based, like so many controversies, on a difference of definition of terms. Prof. Dingle describes the method of science and defines the "logical network" resulting as the "external world". Others might prefer the term "scientific world" or the "scientific picture of the external world". To Prof. Levy the "external world" is what the man of science studies; to Prof. Dingle the result of these studies. So we have words, words, words!

In his letter in *NATURE* of May 25, Prof. Levy describes two schools of thought, and by so doing implies that they are antithetic. One "claims that science is an historical phenomenon produced by human beings in their handling of the world of which they are parts, a social practice . . ."; the other school sees science "as the organisation of our experiences in logical form". I belong to both these schools and see no inconsistency in doing so. I do not, however, accept Prof. Levy's corollary to his description of his first school that the man of science should be responsible for the social consequences of his work. Were such a doctrine to be acted upon, a scientific laboratory would become an arena for the disputes of ethical teachers and party politicians!

C. O. BARTRUM.

32 Willoughby Road,  
Hampstead.  
May 27.

### Social Research

THE leading article on "Road Traffic Research" in *NATURE* of April 13 directs attention once again to the need for scientific research into social problems, for which I contended in my communication in *NATURE* of December 9 (p. 898). The present very unsatisfactory condition of road traffic is but another instance of Government action in a matter of which those responsible have an inadequate knowledge. As is stated in *NATURE* of April 13, "The tragic position of the road traffic problem at the moment and the sterility of all attempts to diminish accidents, whether by motor control, registration, insuring, licensing or deterrent enactments, are due primarily to the omission to base legislation on scientific experiments and definite facts. In the absence of such study, well-intentioned legislation is apt to have consequences and repercussions widely different from or even opposed to those for which it was designed".

This passage emphasises the same need with regard to road traffic problems that my communication emphasised with regard to industrial problems generally, the need, that is, that there should be no legislation on industrial problems unless it is based on carefully ascertained facts, and not only facts concerning the industries themselves, but also (what is at least as important) those showing what previous



legislation has effected. The fact that there has been more industrial legislation in Great Britain during recent years than ever before in our history, and that our industries, instead of being better, are worse now than before, is in itself a proof that investigation is urgently needed. "The acquisition of data is the first necessity." From the study of these data there must gradually emerge principles of guidance in legislative matters of which we are in sore need: no greater benefit can be conferred by science on humanity at large than the discovery of these principles. It can scarcely be hoped that legislation will be on right lines in the absence of this guidance, which science alone can provide.

Let it not be forgotten that our civilisation (of which industry is the main support) has been built up by our forefathers and handed on to us as a precious heritage, and it is our first duty to posterity to see that it does not suffer while under our charge; but is passed on to those who will come after us in a condition somewhat better than that in which we received it; to do less than this we should be guilty of breach of a great trust. We are apt to boast of the great advance made by science, but what will be the verdict of the historian of the far future when, in recounting the history of the critical times through which we are now passing, and in view of later disasters, he makes the astonishing discovery that our legislation was framed without scientific guidance of any kind; that while it has occupied itself with the changes and movements taking place in stars and nebulae millions of light-years away, which can affect our civilisation not at all, it neglected those taking place on our doorsteps on which our very existence depended?

ALAN BLAIR.

Meir,  
Stoke-on-Trent.  
May 4.

### Essential Structural Discontinuities in Certain Adsorbed Films

IN connexion with some recent experimental work, it has been necessary to consider in detail the process of building up an adsorbed film which is formed by the adsorption on neighbouring solid atoms of the two atoms of a diatomic gas molecule, and in which the adsorbed atoms are immobile and stable. Such a film is necessarily imperfect and incomplete, having gaps or holes in it.

For the sake of definiteness, let us consider adsorption on a plane in which each surface atom is surrounded by four equally spaced other atoms. As the film is gradually built up, certain single surface atoms will find themselves surrounded by four filled places. Such atoms will be able to take no part in the adsorption process and will remain bare. The complete film thus of necessity has a sort of irregular mosaic structure.

It is important to know what proportion of the surface atoms remain bare. To do this an experimental numerical test has been carried out in which neighbouring pairs of points on a diagram of such a plane have been selected at random and occupied. It was found that about eight per cent of the total number of surface atoms remain uncovered. In order to test whether the particular assumption about the atomic arrangement is of importance, a similar test was carried out on a hexagonal arrangement, so that there could be six possible places for the second

atom of a molecule to occupy. The numerical result was practically identical.

The actual case under consideration was that of oxygen on tungsten, and experimental evidence for the existence of these gaps has been obtained. The uncovered surface atoms will undoubtedly exert a much greater attraction on impinging oxygen molecules than the other parts of the surface. An adsorbed film of molecular oxygen has been found of the right amount to correspond to adsorption on these gaps in the atomic film.

For the adsorption of molecular oxygen, these gaps must be regarded as active parts of the surface. They would probably also be centres of catalytic activity if one were using a surface from which the atomic film had not been removed. If they were, an amount of oxygen small compared with that required to cover the surface completely would be sufficient to poison it.

A full account of experimental methods and their application to the study of these films is ready for publication, together with a discussion of other properties of the gaps.

In conclusion, it may be pointed out that almost any immobile adsorbed film, except one formed by the adsorption of gas molecules on neighbouring surface atoms without dissociation, will have essential irregularities of a similar type.

J. K. ROBERTS.

Department of Colloid Science,  
Cambridge.  
May 29.

### Lattice Distortion in Nickel-Iron

RECENT investigations of W. A. Wood<sup>1</sup> on the broadening of high-order Debye-Scherrer lines of copper and  $\alpha$ -brass have shown that the lattice distortion may be accompanied by changes in the spacings of various lattice-planes, pointing to a change in shape and (perhaps) size of the unit cell. The occurrence of such an effect can be very clearly shown for nickel-iron. For an alloy with 53 atomic per cent Fe, the side-length of the unit-cube  $a$  is 3.58 A., so that the (400)-reflections with cobalt  $K\alpha_1$  and  $K\alpha_2$  radiation occur at about 85° and 87°

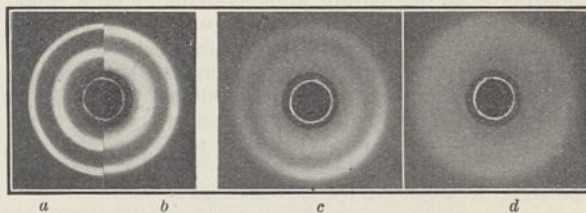


FIG. 1. Nickel-iron (400)-reflection, cobalt  $K\alpha_1 \alpha_2$  doublet.  
a, annealed band.  
b, after 10 per cent compression perpendicular to plane of rolling.  
c, " 2 " stretching parallel to direction of rolling.  
d, " 2 " " at 45° " " " "

respectively, and thus show extremely large dispersion (the distance of the  $\alpha_1 \alpha_2$ -lines for a specimen to film distance of 12 cm. being about 7 mm.). Back-reflection photographs of discs, cut from recrystallised cold-rolled band, show these reflections with great intensity, as the recrystallisation texture is a very pronounced 'cube-texture' ('Würfellaage'), all crystals lying with a cube-face and -side within  $\pm 10^\circ$  parallel to the plane and direction of rolling<sup>2</sup>. The effect of compression-deformation is shown in Fig. 1,

where  $a$  relates to the original disc,  $b$  to the same disc after compressing it to about 10 per cent (the discs were rotated about an axis parallel to the X-ray beam). The shift of the  $\alpha_1, \alpha_2$ -lines amounts to about one sixth of their distance apart, corresponding to a decrease in spacing of about 0.04 per cent.

Wood observed that the rate of broadening of lines from different planes differed likewise<sup>3</sup>. A directional effect was also observed in our case in the sense that the degree of lattice distortion of a definite plane is dependent on the relative orientation of crystal lattice and direction of deformation; for this experiment, strips of the recrystallised band were stretched by about 2 per cent parallel (Fig. 1c) and at 45° (Fig. 1d) to the direction of rolling, that is, nearly parallel to a [100]- and a [110]-direction respectively. The severe distortion in the second case might perhaps be related to the fact, found for aluminium, that crystals stretched in that direction exhibit an extremely pronounced recrystallisation power<sup>4</sup>.

In conclusion, I wish to thank Mr. F. M. Jacobs for his help in taking the photographs.

W. G. BURGERS.

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<sup>1</sup> W. A. Wood, *Phil. Mag.*, **18**, 495; 1934. **19**, 219; 1935.

<sup>2</sup> W. G. Burgers and J. L. Snoek, *Z. Metallk.*, in press.

<sup>3</sup> Compare also G. W. Brindley and F. W. Spiers, *Proc. Leeds Phil. Soc.*, **3**, 4; 1934. V. Caglioti and G. Sachs, *Z. Phys.*, **74**, 647; 1932.

<sup>4</sup> W. G. Burgers, *Pap. and Disc. Intern. Conf. Physics*, London, **2**, 139; 1934.

#### Lattice Parameters of Solid Solutions in Silver

IN continuation of work on valency effects in alloys, I have recently measured the lattice parameters of the primary solid solutions in silver formed by the elements cadmium, indium, tin and antimony, which follow immediately after silver in the Periodic Table. This work has led to the discovery that in dilute solid-solutions of these elements, the alloys of the same equivalent composition have identical lattice parameters. By the term equivalent composition is meant the atomic percentage of the solute element multiplied by its valency, and the above relation implies that if the lattice parameters of the alloys are plotted against the equivalent compositions, the points for all of the four alloy-systems lie on a single curve. Alternatively, it may be said that the initial expansion of the silver lattice produced by one atom of the above elements is proportional to the valency.

The relation is thus of the same type as that previously found for the depression of freezing point of silver by the same elements, and may perhaps indicate an effect proportional to the repulsion between a solute and a solvent ion.

WILLIAM HUME-ROTHERY.

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May 24.

#### Dipole Moments of Ethyl and Phenyl Isocyanates

THE dipole moments<sup>1</sup> and the Raman spectra<sup>2</sup> indicate that the isothiocyanate group,  $-N=C=S$ , is linear. The isocyanates are now found to resemble the isothiocyanates. The Raman spectra indicate that the group  $-N=C=O$  in the isocyanic esters is linear<sup>3</sup>, and this conclusion agrees with inferences drawn from the dipole moments.

Ethyl and phenyl isocyanates we find to have moments of 2.81  $D$  and 2.28  $D$  respectively. No other value for the ethyl compound is available, but the published results for phenyl isocyanate are 2.34  $D$  at 18° in benzene<sup>4</sup> and 2.23  $D$  at 25° in carbon tetrachloride<sup>5</sup>, the mean being 2.28  $D$ .

The difference between the moments of the corresponding isothiocyanate and isocyanate gives the value of the excess of the  $C=S$  over the  $C=O$  moment. This difference deduced from other compounds is given below.

Ethyl isothiocyanate	3.31	} 0.50	Phenyl isothiocyanate	3.00	} 0.72
Ethyl isocyanate	2.81		Phenyl isocyanate	2.28	
Thiobenzophenone	3.37	} 0.42	Dianisyl thioketone	4.44	} 0.54
Benzophenone	2.95		Dianisyl ketone	3.90	

Bergmann has published two values of the moment of phenyl isothiocyanate, namely<sup>6</sup>, 2.76  $D$  and<sup>4</sup> 3.00  $D$ , and it will be seen that the former value exceeds the moment of phenyl isocyanate by 0.48  $D$ . The other figures are in satisfactory agreement with each other.

The solvent used in the present experiment was benzene, and measurements were at 20°. Ethyl isocyanate, prepared from potassium ethyl sulphate and potassium cyanate, was twice fractionated, dried by sodium sulphate and refractionated. The moment was measured immediately. The physical constants were: boiling point, 59.8°/759 mm.;  $d_4^{20}$  0.9031;  $n_D^{20}$  1.3808. Phenyl isocyanate from Kahlbaum was dried and fractionated: boiling point, 161.7°/752 mm.;  $d_4^{20}$  1.0946;  $n_D^{20}$  1.5363.

	$P_{20}$	$PE$	$\mu$
Ethyl isocyanate	185 c.c.	18.3 c.c.	2.81 $D$
Phenyl isocyanate	144 c.c.	33.9 c.c.	2.28 $D$

The details of these results and those for analogous compounds will shortly be published.

J. R. PARTINGTON.  
E. G. COWLEY.

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University of London.  
May 17.

<sup>1</sup> Hunter and Partington, *J. Chem. Soc.*, 2825; 1932.

<sup>2</sup> Langseth, Nielson and Sorensen, *Z. phys. Chem.*, **B**, **27**, 100; 1934.

<sup>3</sup> Goubeau, *Ber.*, **68**, 912; 1935.

<sup>4</sup> Elde and Hassel, *Tids. Kjemi*, **10**, 93; 1930.

<sup>5</sup> Sidgwick, Sutton and Thomas, *J. Chem. Soc.*, 406; 1933.

<sup>6</sup> *Z. phys. Chem.*, **B**, **10**, 397; 1930.

<sup>7</sup> *ibid.*, **B**, **17**, 100; 1932.

#### Interchange of Heavy Atoms in Organo-Metallic Compounds

THE interchange of heavy atoms in organo-metallic compounds, reported by Mrs. Leigh-Smith and Dr. Richardson<sup>1</sup>, using the radioactive indicator method, is in line with work done by Hilpert and Grüttner<sup>2</sup>, who, however, found evidence of detachment of the organic radicals from the metal. They found that a reversible reaction took place between mercury diphenyl and metallic bismuth, with formation of a little diphenyl, at 250° in hydrogen.

When working on alkyl bismuth compounds under the direction of Prof. W. J. Jones at Cardiff, I attempted to prepare mixed alkyl-bismuthines, and obtained results indicating some looseness of binding between the bismuth atom and the alkyl residues. On treating amyl bismuth dichloride with ethyl magnesium bromide, triethylbismuthine and tri-*n*-amyl-bismuthine were obtained in addition to *n*-amyl-diethyl-bismuthine. Challenger<sup>3</sup> obtained similar results with ethyl magnesium bromide and

diphenyl-bromobismuthine, suggesting that organic radicals are readily liberated from their compounds with bismuth.

Exchange of metal atoms will probably occur with many typical organo-metallic compounds, where the link between carbon and metal is weaker than that between carbon and a non-metal of the same group of the Periodic Table; also, the strength of binding decreases with increasing atomic weight of the central atom.

1 Station Hill,  
Maesteg, Glam.  
May 27.

I. NORVICK.

<sup>1</sup> NATURE, 135, 828, May 18, 1935.  
<sup>2</sup> Ber., 46, 1685; 1913.  
<sup>3</sup> J. Chem. Soc., 105, 2210; 1914.

### Synthesis of Dehydroandrosterone by the Decomposition of $\gamma$ -Sitosterol from Soya Beans

Two substances have been isolated from the urine of men which resemble the male hormone in their ability to stimulate the growth of the capon's comb<sup>1</sup>. One of these, androsterone, described in detail by Butenandt and Tscherning<sup>2</sup>, has been produced artificially by Ruzicka and his collaborators<sup>3</sup> by means of the oxidative decomposition of epi-dihydrocholesterol acetate, and has thereby been recognised as 3-epi-oxy-allo- $\alpha$ -etio-cholanone-(17). A second oxyketone containing two hydrogen atoms less has been obtained by Butenandt and Dannenbaum<sup>4</sup> from an unsaturated chloroketone, C<sub>27</sub>H<sub>44</sub>OCl, occurring in extracts of urine, by replacement of the chlorine atom by a hydroxyl group. On carrying out the analogous replacement reaction using the saturated chloroketone, androsterone was obtained. These reactions leave the question unanswered as to the position of the double bond and the steric position of the hydroxyl group.

I have elucidated this by carrying out the synthesis of the hormone by means of the decomposition of one of the known sterols. Acetylated sitosterol obtained from soya beans was chlorinated in the 5,6-position in order to protect the double bond, and the side chain was afterwards removed by vigorous oxidation with chromic acid, more or less according to the classical method of Ruzicka by which the identity of the ring system of sitosterol and cholesterol has been determined<sup>5</sup>. From the dechlorinated and saponified reaction mixture, a sparingly soluble semi-carbazone was obtained; this, after hydrolysis, gave beautiful crystals of an oxyketone which proved to be chemically and physiologically identical with dehydroandrosterone obtained from urine in this laboratory. This oxyketone has a melting point at 147°-148° C. (corr.), the mixed melting point with dehydroandrosterone showing no depression; oxime, leaflets or needles, melting point and mixed m.p. 190° C. (corr.); benzoate, melting point 252°-253° C. (corr.); specific rotation, +13.5° in absolute alcohol. The capon unit is about 210 $\gamma$ , which is the same as the dose required of natural dehydroandrosterone (androsterone=70 $\gamma$ ). Dehydroandrosterone is therefore 3-oxy- $\Delta$ -5-6- $\alpha$ -etiocholanone-(17).

This configuration of the ring system is similar to that of sitosterol and cholesterol, which is interesting in as much as it has been found possible, by a modification of the existing process (K. David<sup>6</sup>) to

prepare, in this laboratory, dehydroandrosterone from urine in almost the same quantity as androsterone.

The details of this work will be published elsewhere.  
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May 17.

<sup>1</sup> J. Pharm., 40, 27; 1930.  
<sup>2</sup> Z. physiol. Chem., 229, 167; 1934.  
<sup>3</sup> Helv. Chim. Acta, 17, 1389; 1934.  
<sup>4</sup> Z. physiol. Chem., 229, 192; 1934.  
<sup>5</sup> Helv. Chim. Acta, 18, 430; 1935.  
<sup>6</sup> Acta. brev. Neerl., 5, 1-2, 31; 1935.

### Selective Accumulation of Lipochrome

It is well known that different animals deal with carotenoids derived from vegetable sources in various ways. The adipose tissue of the horse and the cow contain considerable amounts of polyene-hydrocarbons (carotenes), but it does not accumulate polyene-alcohols (xanthophylls). A precisely opposite selection would appear to take place in the fat of the hen.

We tried to locate the organ in which this selection takes place and chose the horse for the following experiment. The blood serum of the horse is free from xanthophyll, and therefore the elimination of this carotenoid takes place before it enters the general circulation. So the question arises, whether the polyene-alcohols are not absorbed at all by the gut, or whether they reach the liver and are transformed or eliminated there. To choose between these alternatives, we took blood samples, therefore, while absorption of large amounts of green food was going on, from the portal vein of a narcotised horse. No xanthophyll was found in the serum, the lipochrome of which was identical with that taken from the jugular vein; but the carotene content was found to be increased.

This observation makes it quite probable that xanthophylls do not cross the wall of the gut and that selection already takes place in the digestive organs of the horse.

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May 18.

### Keratin Digestion in the Larvæ of the Clothes Moth

THE digestion of keratin in the larvæ of the ordinary clothes moth, *Tineola biselliella*, was investigated by means of the micro-methods developed by Linderstrom-Lang and Holter. In the secretion of the middle intestine a powerful proteinase was found having a pH optimum about 9.3 (40°, splitting up casein) and, contrary to animal trypsin-kinase, being but little sensitive to addition of thiol compounds (sodium sulphide, sodium thioglycolate). The pH of the secretion of animals fed with wool was about 10 (measured with the glass electrode in a carbon dioxide free chamber) and gave a strong nitroprusside reaction which was most clearly visible in the half-digested hairs present as contamination in the secretion. The reaction disappeared soon after the secretion had been exposed to the air; only a very small further visible change of the hairs was

observable when the secretion (with half-digested hairs) was kept in a moist chamber after removal from the intestine. Animals fed with cotton wool or filter-paper (made inviting to the animal by covering it with a thin film of casein and wool-fat) gave scarcely any nitroprusside reaction, but the reaction reappeared when cystin was added to this food (although this is left quite undigested by the animal).

It was therefore assumed that the secretion contains an agent capable of reducing the S — S bonds in the hair (see Astbury<sup>1</sup> and Speakman<sup>2</sup>, Goddard and Michaelis<sup>3</sup>) but auto-oxidisable in the air. The reduction of the hair keratin opens its peptide chains to the attack of the proteinase (Goddard and Michaelis) the activity of which is but little influenced by the low oxidation-reduction potential of the medium. The nature of the reducing agent is unknown. It is not a thiol compound. Its reducing power may be estimated from the accompanying table, which records some experiments on the reduction of certain dyes in the middle intestine (see also Titschack<sup>4</sup>).

Dye	$E_h$ at pH 10	Animals fed with wool stained with dyes. SH +. (Reducing agent having reacted with S — S)	Animals fed with cotton wool stained with dyes. SH —. ("Pure reducing agent")
Methylene blue	— 0.08	reduced	reduced
Indigo tetrasulphonate	— 0.13		
Indigo disulphonate	— 0.22	partly reduced	partly reduced
Gallophenine	— 0.29		
Brilliant alizarine blue	— 0.34	not reduced	not reduced
Rosinduline GG.	— 0.44	"	"

Experiments on the digestion of sheep wool by the moth proteinase *in vitro* using sodium thioglycolate as reducing agent at pH 10 (Goddard, Michaelis) showed a rapid splitting-up of the wool with formation of equivalent quantities of amino and carboxylic groups. Under the same conditions pancreatic trypsin-kinase with the same activity towards casein had no effect, due to inhibition by the thiol compounds.

The experiments are being continued.

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F. DUSPIVA.

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May 23.

<sup>1</sup> W. T. Astbury, *Trans. Faraday Soc.*, **29**, 103; 1933.

<sup>2</sup> J. B. Speakman and Hirst, M.C., *Trans. Faraday Soc.*, **29**, 148; 1933.

<sup>3</sup> D. R. Goddard and L. Michaelis, *J. Biol. Chem.*, **106**, 605; 1934.

<sup>4</sup> E. Titschack, *Z. tech. Biol.*, **10**, 92; 1922.

### Mechanism of Respiration

In a previous letter<sup>1</sup>, I discussed the respiration of the minced breast muscle of the pigeon. In this material succinic acid seems to play by its reversible two-step oxidation to fumaric and hydroxyfumaric acid an important rôle as catalytic hydrogen carrier.

Dr. K. A. C. Elliott<sup>2</sup> ascribes my results to a simple methodic error, and doubts the possibility of generalisation. Owing to the nature and bulk of evidence, discussion is impossible within the limits of these columns. I must refer to the complete paper which I hope to publish soon. Our recent experiments confirm our previous results and show that at any rate a limited generalisation is warranted. Of the two steps of oxidation: succinic to fumaric

acid and fumaric to hydroxyfumaric acid, the latter is quantitatively the more important. Malic acid is not activated. The apparent activation of this substance is due to the presence of fumarase. This might explain Elliott's results.

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May 15.

<sup>1</sup> NATURE, **135**, 305, Feb. 23, 1935.

<sup>2</sup> NATURE, **135**, 762, May 4, 1935.

### Giant Cells in Insects Parasitised by Hymenopterous Larvæ

In a recent paper, A. Pailot<sup>1</sup> directs attention to the giant cells present in aphids parasitised by Hymenoptera, and he affirms that these cells originate from the sexual cells of the host. In support of this conclusion, Pailot states that he has once observed in a female of *Chaetophorus aceris*, parasitised by *Aphidius ribis*, Hal. a group of cells (considered by him to be germinal cells) in process of dispersion, and that these elements already showed the structure of giant cells.

Giant cells, appearing as opaque white globules of various sizes, are invariably present in weevils of *Sitona lineata*, L., containing immature larvæ of the braconid, *Dinocampus (Perilitus) rutilus*, Nees. Investigation<sup>2,3</sup> has shown that these cells are the hypertrophied cells of the embryonic membrane of the parasite egg. When the larva emerges from the chorion, the cells of the embryonic membrane dissociate and become free in the body cavity of the host. They then increase greatly in size, absorbing fatty matter from the body fluid. They constitute the principal food of the larva in its later stages. It was found that these cells continued their development even should the parasite larva die young, and they may then attain an abnormally large size. This point is of interest in view of Pailot's statement that he has found giant cells present in aphids without a developing parasite larva, and in such cases he considered that the parasite embryo had been completely reabsorbed.

Dissociation of the cells of the embryonic membrane, either singly or in groups, and their persistence during parasitism, has been observed<sup>1</sup> in various parasitic Hymenoptera, and the literature on this subject has already been discussed<sup>2</sup>. Since then, a paper by Oglobin<sup>4</sup> has come to my notice, in which he gives a detailed description of the origin and development of the giant cells in *Dinocampus terminatus*, and his account agrees in all essentials with my observations on *D. rutilus*. Further contributions to this subject are to be found in Parker's studies of *Macrocentrus gifuensis*, Ashmead<sup>5</sup>, and *Meteorus nigricollis*, Thomson<sup>6</sup>. In the Aphidiini, Spencer<sup>7</sup> has found that the serosa breaks up into pieces when the larva hatches. The serosal fragments become rounded off and increase in size. They are afterwards eaten by the larva. I have no doubt that these serosal fragments constitute the "giant cells" observed by Pailot.

In an earlier paper<sup>8</sup>, Pailot comments on the giant cells found in caterpillars of *Pieris brassicae*, and he considers that they originate from the ordinary elements of the blood of the host. He suggests that the influence inducing the hypertrophy of these cells

may be connected with the presence of the larvæ of *Apanteles*. Faure<sup>9</sup> has found that the presence of giant cells in the blood of caterpillars of *P. brassica* is a sure indication of parasitism by *Apanteles* larvæ. Grandori<sup>10</sup> has described how in *A. glomeratus* the cells of the embryonic membrane dissociate when the larva hatches, and he states that these cells preserve their vitality to the end of the larval life. It is therefore highly probable that, in this case also, the giant cells referred to by Paillot are derived from the embryonic membrane of the parasite.

It is not yet known in how many groups of parasitic Hymenoptera dissociation of the embryonic membrane and later hypertrophy of the cells occur, and it is probable that in many forms no such phenomena take place. Chrystal<sup>11</sup> observed that, in the cynipoid, *Ibalia leucospoides*, Hoehenw., no dissociation of the trophamnion occurred, and in the ichneumon, *Pimpla examinitor*, F., I have been unable to find either a cellular membrane or dissociated cells in the egg at the time of hatching, though at an earlier stage the embryonic membrane is distinct.

DOROTHY J. JACKSON.

North Cliff,  
St. Andrews.  
June 5.

<sup>1</sup> C.R. Acad. Sci., 199, 1450; 1934.  
<sup>2</sup> NATURE, 113, 353; 1924.  
<sup>3</sup> Proc. Zool. Soc., 597; 1928.  
<sup>4</sup> Pub. Inst. Zool. Univ. Charles, Prague, 5, 1; 1924.  
<sup>5</sup> Tech. Bull., U.S. Dept. Agric., 230; 1931.  
<sup>6</sup> Proc. Ent. Soc. Wash., 33, 93; 1931.  
<sup>7</sup> Ann. Ent. Soc. Amer., 19, 119; 1922.  
<sup>8</sup> C.R. Soc. Biol., 81, 187; 1918.  
<sup>9</sup> "Contribution à l'Étude d'un Complexe biologique: La Piéride du Chou (*Pieris brassicae*, L.) et ses parasites Hyménoptères". Lyon, 1926.  
<sup>10</sup> Redia, Florence, 7, 363; 1911.  
<sup>11</sup> Oxford Forestry Memoir, 11; 1930.

The Breeding of a Grey Mullet, *Mugil capito*, Cuv., in Lake Qarun, Egypt

THE common grey mullets of Egypt, *M. cephalus* (Linn.) and *M. capito*, Cuv., feed and grow in the delta lakes and are presumed to spawn near the sea coast.

Lake Qarun lies some two hundred kilometres south of the Mediterranean coast. The salinity is increasing and the gradient between fresh and salt in the water is such as to resemble the delta habitats of the mullets.

In the autumn of 1928 one of us succeeded in introducing to this lake 20,000 live fry, chiefly of *M. cephalus*, the larger of the two species. As these fry grew up but did not give rise to any second generation, continuous stocking was resorted to from 1932 onwards, with results that are shown in tabular form below:

Year	Date of fry transfer	Number of fry introduced	Mullet landings in kgm. <i>M. cephalus</i> 1929-31, and <i>M. capito</i> after		Salinity 1 km. east of Quallieh Island in parts per 1000
			<i>M. cephalus</i>	<i>M. capito</i>	
1928	Sept.-Dec.	20,000	—	—	17-19
1929	—	—	181	—	17-34
1930	—	—	427	—	17-30
1931	—	—	52	—	20-00
1932	16 11 31	154,000	1,154	—	22-40
	10 1 32				
	12 11 32				
1933	to	136,080	2,792	—	21-29
	9 1 33				
	2 12 33				
1934	to	257,460	42,275	—	18-19
	11 2 34				
	2 12 34				
1935	to	258,600	132,060	—	—
	4 8 35				

(Jan.-March)

Up to 1933 the weight of mullet taken from the lake bore a rough proportion to the fry introduced, but since 1934 there has been a progression of the catch (chiefly *M. capito*) that could only have been due to natural reproduction, and is out of all proportion to the fry introduced. Moreover, in a tow-net sample collected on October 24, 1934, several stages of developing eggs and larvæ were found. These can only be referred to *M. capito*, and represent the first definite identification of these stages of the species. A description will shortly be published elsewhere.

R. S. WIMPENNY.

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H. FAOUZI.

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Human Remains from Kanam and Kanjera, Kenya Colony

IT was with much regret that I learned that space could not be found for my reply to Prof. P. G. H. Boswell's letter in NATURE of March 9 (p. 371) about the human remains at Kanam and Kanjera. Many readers of NATURE will doubtless have wondered why no comment has appeared over my signature. I would be grateful if now you would insert this brief note, and the whole matter can then be left for full discussion on my return to England at the close of my present Expedition.

L. S. B. LEAKEY.

East African Archaeological Expedition,  
c/o P.O., Arusha,  
Tanganyika Territory.  
May 28.

[DR. LEAKEY'S reply to Prof. Boswell's letter would have occupied several columns of NATURE, and space could not possibly be found for it. The suggestion was, therefore, made to Dr. Leakey that he should send a short reply to the specific points stated by Prof. Boswell and deal with them in detail in a communication to a scientific society. EDITOR, NATURE.]

Polyphyletic Origin of Metazoa from Plants

BOTANISTS show us an aspect of evolution-in-progress, so far as that can be shown, of which zoologists tell us nothing—because there is possibly nothing to tell. The evolution of plants is often indicated in terms of the appearance of the sexual differentiation in unicellular organisms, of the appearance of multicellularity, of the total life-cycle of one plant as an alternation of two generations, asexual and sexual, the individuals being sometimes morphologically distinct and independent, and of the various fate of these phases of the total life-cycle in, say, the moss, the fern and the angiosperm, when they are not distinct and independent individuals, "but the one remains permanently connected to the other like a parasite on its host plant" in Strasburger's words.

This aspect of evolution applies just as much to animals as to plants; the vertebrate, like the angiosperm, is an integration of two phases of a life-cycle, the sexual phase being greatly reduced; and other

metazoan phyla exhibit other modes of development of the life-cycle. But they do not exhibit the development 'in progress', so to speak; each exhibits a particular mode established. There is as great a diversity among animals as among plants as to what constitutes what may be called the individual, and there is no trace at all of the development of such diverse types of individual—in *animal* evolution.

At the same time there is a conspicuous lack of plausible genetic affinities among the animal phyla. Zoologists make half-hearted suggestions as to phyletic affinities and with more heart indulge themselves in the construction of hypothetical ancestral forms for the different phyla. But once the possibility is entertained of deriving metazoan phyla from the

less specialised multicellular plants, it is easy to see why Echinoderms, especially the extinct Crinoids, are such paradoxical animals; *Hydra viridis* and *Convoluta roscoffensis* are no longer dubious cases of symbiosis but animals which retain something of the character of their plant ancestors; vertebrates may be traced back, through the tail of the larval Ascidian and the Tunicates with no tailed larva stage in their development, to perhaps a red alga; and there may be more than a jingling verbal relationship between Bryophyta and Bryozoa.

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May 24.

### Points from Foregoing Letters

PROF. J. W. MCBAIN considers the association of molecules as the characteristic factor in colloids, and raises the question how far it is effective in the case of long chain molecules. He states that in concentrated solutions of simple sulphonic acid, molecular association, rather than inter-ionic attraction, is responsible for the increase in conductivity, freezing point lowering, etc.

The Raman spectra of benzenes containing heavy hydrogen ( $C_6D_6$  and  $C_6H_5D$ ) are described by a group of seven investigators from University College, London, and are compared with observations by Klit and Langseth. The evidence, it is stated, permits the view that the benzene molecule has a plain regular hexagonal structure ( $D_{6h}$  symmetry).

Prof. J. Kaplan submits an afterglow spectrogram obtained by passing a current of low density through nitrogen. It shows a great enhancement of the relative intensity of the Vegard-Kaplan bands which, the author maintains, agree closely with the radiations from the night sky. With a rapidly interrupted discharge and low current the relative intensity of the green auroral line is also greatly increased, suggesting that it may arise in the afterglow.

A new method of calculating the charge of an electron from the electronic diffraction produced by crystals, has been devised by S. v. Friesen (by combining de Broglie's equation with the formula for the Rydberg constant). Preliminary measurements give a value of  $4.796 \times 10^{-10}$  e.s.u., as compared with  $4.77 \times 10^{-10}$  by the oil drop method and  $4.80 \times 10^{-10}$  from X-ray diffraction measurements.

A communication from the Optical Institute, Leningrad, states that experiments carried out in the exceptionally clear atmosphere of the southern slopes of Mount Elbruz (Caucasus) with the view of detecting solar infra-red radiation of wave-lengths longer than  $11 \mu$  have given negative results.

Dr. J. K. Roberts discusses the adsorption of diatomic gas molecules on solid surfaces, and concludes that the resulting adsorbed films are not continuous. Certain single surface atoms remain bare and may afterwards show catalytic activity.

X-ray diffraction photographs of a nickel-iron alloy distorted by cold working are submitted by Dr. W. G. Burgers. They show that compression and stretching change the shape and perhaps the size of the lattice-spacing.

The addition of cadmium, indium, tin and antimony to silver, changes its lattice structure and depresses the freezing point by an amount proportional to the valency of the added element, according to W. Hume-Rothery.

The dipole moments of ethyl and phenyl isocyanates have been determined by Prof. J. R. Partington and E. G. Cowley. From the values obtained, they infer that the  $-N=C=O$  group in these compounds is linear, as is also indicated by the Raman spectra of the light they scatter.

I. Norvick mentions a reaction between alkyl-organic compounds of bismuth and of magnesium in which, as in the case recently described by Mrs. Leigh-Smith and Dr. Richardson, bismuth atoms were apparently able to wander from one organic radicle to another.

Starting with sitosterol, a constituent of soya beans, R. V. Oppenauer has synthesised one of the male sex hormones (dehydroandrosterone), thus elucidating its structure, which was hitherto incompletely known.

The horse and cow store carotenes in their fatty tissues, while the hen stores the closely related xanthophylls, all of which are derived from vegetable sources. Messrs. L. Zechmeister, P. Tuzson and E. Ernst find that, after feeding on green food, the blood serum of the horse shows an increase of carotenes and no xanthophylls. Hence the selection appears to take place in the digestive organs.

According to K. Linderström-Lang and F. Duspiva, the clothes moth, *Tineola biselliella*, digests wool keratin by means of an enzyme active in alkaline medium (pH 9.3), after the keratin has been chemically reduced by an agent as yet unknown.

Giant cells found in weevils of *Sitona lineata* and other insects parasitised by hymenopterous larvae are derived, Miss Dorothy J. Jackson states, from the embryonic membrane of the larvae, which become dissociated when the larvae emerge from the chorion; they do not arise from the host's cells, as suggested by Paillot in the case of *Chaitophorus aceris* and in caterpillars of *Pieris brassicae*.

ERRATUM. It was stated in the summary of a letter in the issue of June 8, that an external magnetic field *increases* the resistance of nickel-iron wires at audio-frequencies. Actually, as the letter indicated, the application of an external field *decreases* the resistance.

## Research Items

**Romano-British Potters' Stamps.** Students of Romano-British antiquities will welcome a further list of potters' stamps on *terra sigillata* from Gloucester, which has been published by Mr. Charles Green, curator of the Public Museum (Occasional Papers No. 2, Public Museum, Gloucester, pp. 12, 6d.). The examples included in this second list are part of the results of extensive excavations which were carried out early in 1934 in King's Square, Gloucester. The trenches pierced the north-east angle of the wall of Glevum and for some distance ran parallel to the east wall. More than forty of a large number of potters' stamps proved to be legible, and form the basis of this catalogue; but a few recently discovered stamps from other parts of the city are included. Fifteen of the stamps may antedate the foundation of the *colonia* of Glevum, the remainder are of the second century A.D. The majority of the stamps belong to various potters of Lezoux, a number come from La Gouffrenque, and two from Rheinzabern. A detailed study of the Romano-British pottery which has been found in Gloucester is now in course of preparation.

**Natives of Angola.** Although the Portuguese have been established in Angola for more than four centuries, it is only recently that this vast territory of 1,200,000 square kilometres has been penetrated completely and subdued. Its pacification is now so complete that M. Christian de Caters has traversed it in all directions, from frontier to frontier, without arms (*La Nature*, May 15). The natives are estimated to number between four and five millions, nearly all of Bantu race, though there are a few scattered tribes of Bushmen, leading a miserable existence, in the centre. The Bantu, however, are divided into an extraordinarily large number of branches. On the coast the natives have entirely lost their indigenous culture. In the north-west the Fiot or Congo, who extend from the Cabinda enclave to the neighbourhood of Loanda, have lost their culture near the railway, but in the remoter parts, although they preserve the record of their contact with civilisation in their houses, which are of European form, in which the walls are decorated with drawings of locomotives, steamboats and other like objects, they have abandoned European dress. Farther east is one of the most interesting of the groups in Angola, the Lundas. Inhabiting a country which is sparsely wooded or savannah, they live by hunting with bow and lances of a peculiar and interesting form. A characteristic weapon is a club in the form of a human head. Some of these are negroid, others of a refined type recalling Egyptian or primitive Greek characters. Their fondness for dancing and fear of fetish are marked. Their musical instrument is the marimba or xylophone. Fear of fetish places them at the mercy of sorcerers, who are not slow to profit thereby. They are particularly skilled in the use of poisons. Generally the Lunda wear no clothes. The women dress their hair with a mixture of oil and red ochre. Sometimes they wear a species of cap in brick-red and the whole of the body may be covered with a red powder.

**Body Fluids of Aquatic Animals.** In his presidential address before the Linnean Society of New South

Wales, at its annual general meeting on March 27, Prof. W. J. Dakin gave an account of the relation between the osmotic pressure and the salt contents of the blood and body fluids of aquatic animals to the constitution of the external medium. After touching upon the early history of the subject he dealt with his own early work, and showed how at first it seemed as if all the aquatic invertebrates were to be regarded as highly dependent upon the constitution of the water bathing their bodies, whereas the fishes and all the animals above them (reptiles, amphibia, birds and mammals) had evolved an independence which was most striking in the aquatic groups of the fishes. The fact that the bounding membranes of all these animals can be shown to be permeable to water and probably to salts makes the search for the controlling mechanism one of the fundamental problems in biology. Prof. Dakin discussed the possible origin of the independence so characteristic of vertebrate blood and disagreed with the theories of Macallum that the salinity of vertebrate blood represented that of a primeval ocean in which the provertebrates had evolved. He showed that it was possible for an aquatic invertebrate to sustain a similar independence in fresh water, and that it was quite likely that the early aquatic vertebrates had evolved their independence in fresh water. On the other hand, the salt contents of living cells as well as of body fluids might well be a relic of the origin of life in water.

**Breeding of a Japanese Fresh-water Bivalve.** K. Okada (*Sci. Rep. Tôhoku Imp. Univ.*, 9, No. 4, 1935) has studied the nutrition of the embryos of *Musculium heterodon*, a Japanese fresh-water mollusc allied to the British fresh-water bivalve, *Sphaerium corneum*. When the fertilised eggs come into the interspaces between the interlamellar junctions of the inner gill, the walls of adjacent junctions are eroded and thus a cavity is formed the wall of which thickens, apparently by the addition of blood corpuscles, and thus the marsupial sac is formed. Its wall is single-layered and envelops eggs which are in cleavage. Three or four such sacs fuse and form a larger sac, the wall of which becomes two-layered and contains embryos beyond the gastrula stage. This sac becomes still larger and displaced more dorsally and the embryos remain in it until they attain the form of the adult and are about 2 mm. long. The outer layer of the sac is the original single wall, the inner layer originates from blood corpuscles which have migrated into the sac from the hæmocœl, and the young mollusc is nourished at the expense of these blood cells of the parent.

**Insects Collected by the Kalahari Expedition.** Certain of the scientific results of the Vernay-Lang Kalahari Expedition, 1930, are reported upon in the *Annals of the Transvaal Museum*, 16, Part 4, Feb. 1935. The collecting of specimens took place between the months March and September and, since this period was at the close of the rainy season, the material obtained was not so abundant as might have been expected had the work taken place earlier. The Sphegidae and Psammocharidae are dealt with by Dr. G. Arnold, who describes five new species and one new variety belonging to the first mentioned

family and two new species of Psammocharidæ. In Dr. A. J. Hesse's account of the Mutillid wasps, he records 11 genera and 31 species of the family, of which 8 species were previously undescribed, together with several minor forms. This same authority is also responsible for working out the beetles of the family Tenebrionidæ—a group represented by more than 2,300 specimens. This extensive collection, although exceedingly rich in numbers, is comparatively poor in genera and species which were obtained by the expedition on their journey through the extensive region of Nganiiland and northern Bechuanaland. It is, however, of special interest, since no material has been hitherto available from the Kalahari Desert. Out of 114 species obtained, 16 are described for the first time. The other reports in the present contribution deal with the Heteroptera, the blood-sucking Diptera and the Trypetidæ.

**Bird Malaria.** K. S. Shah (*Amer. J. Hyg.*, 19, 392-403; 1934), in view of the deficient information and divergent views on the incidence and development of gametocytes (crescents) in human malignant malaria (*Plasmodium falciparum*), has investigated birds infected with the malaria parasite *Plasmodium cathemerium*, which resembles in morphology and life-cycle the species *falciparum*. He states that when the canary is infected with *P. cathemerium*, gametocytes appeared in the peripheral circulation early in the infection and in the majority of cases simultaneously with the asexual forms. The number of gametocytes increased with the increase in asexual forms and the incidence was highest at the peak of infection; the number of gametocytes diminished with the fall of the infection. In a later paper in the same journal (pp. 502-507; 1934) Shah, Rozeboom and del Rosario record that gametocytes were present in sufficient numbers in the peripheral blood, during the early period of patency, to infect mosquitoes (*Culex pipiens*), that the chances of mosquitoes becoming infected were greater when they were allowed to feed at night than during the day, and that when canaries were experimentally infected with sporozoites the gametocytes appeared in the peripheral blood early in the infection and in most cases simultaneously with the asexual forms.

**Eelgrass in the Atlantic.** Many interesting problems were presented to biologists and to all interested in problems connected with the Atlantic coast-line, by the rapid diminution, reported from both the American and European sides of the Atlantic Ocean during 1931 and 1932, of the eelgrass (*Zostera marina*), which grows on mud shores, at levels where it is usually submerged by the sea. The plant is widespread and ordinarily grows in dense mats on the mud flats of bays and estuaries, and as its disappearance was often extremely rapid so that 99 per cent of the original vegetation disappeared within one season, the phenomenon was exceedingly striking and aroused widespread attention. A very interesting summary by Clarence Cottam, of the data accumulated as a result, is issued by the United States Department of Agriculture, as *Wildlife Research and Management Leaflet*, BS-3, February 1935. Many causes have been suggested for the widespread disappearance of the plant, which has not been associated with any similar disappearance of the species of *Zostera* fringing the Pacific coast-lines. Several parasitic causes have been suggested (see NATURE, 134, 416;

1934), and these are briefly reviewed and the complexity of the problem stressed. Eelgrass has many direct commercial uses in different countries, as an insulator, as a packing material, in upholstering, etc., but its main biological importance is as a food or as a sheltering habitat for the natural food of many waterfowl. The effect of its general disappearance is closely examined. It normally forms more than 80 per cent of the food of the sea brant, and there is evidence that the numbers of this species on the coast of North Carolina were very seriously reduced (down to 2 per cent) in the winter of 1934-35 as compared with 1929-30. Fortunately, in other areas the reduction has not been so severe. The writer points out that there is evidence that previous periods of scarcity of eelgrass have been experienced on the Atlantic seaboard, and he finds some evidence for a recovery of the plant in certain areas, both on the American and European coasts.

**Water Mould Fungi.** A paper by Miss Evelyn J. Forbes (*Trans. Brit. Mycol. Soc.*, 19, Part 3, 221-239, February 1935) reports a study of water fungi, using methods recommended by American workers. Samples of water are 'baited' with sterilised hemp seed, which induces the fungi to grow. Cultures are purified by teasing out hyphæ under a binocular microscope and removing pieces bearing spores to plates of malt agar or corn meal agar. Samples of natural waters from the Bristol district yielded twenty-two species of aquatic fungi, fourteen of which are new to Britain. The new records include ten species of the genus *Achyla*, two of *Rhipidium*, one of *Calyptrolegnia*, and one of *Brevilegnia*. The species are described in detail, and three plates further enrich their characters.

**Microseisms at Kew.** In a recent memoir (*Meteorological Office Geoph. Mem.*, No. 66; 1935), Mr. A. W. Lee continues his interesting studies on microseismic disturbances recorded by the Galitzin seismograph at Kew. The north-south, east-west and vertical components of the microseisms have been tabulated for four hours daily throughout the year 1932. The mean amplitudes and periods for the whole year of the three components are approximately equal (0.9 $\mu$  and 5.6 sec.). The amplitudes of the two horizontal components are nearly equal for all periods, but the ratio of the horizontal to the vertical amplitudes decreases from about 1.2 for microseisms of period 4½ sec. to 0.85 for those of period 9 sec., a variation that is consistent with the hypothesis that the microseisms may be regarded as Rayleigh waves through granite covered by a superficial layer. The vertical component is more trustworthy than either of the horizontal components for the measurement of microseisms, as there are no uncertainties due to changes in the direction in which the waves travel, and it is less affected by the local geological structure. Since the beginning of the present year, it has therefore been used for the tabulation of microseisms at Kew Observatory.

**Snow Crystals Observed in Japan.** In the *Journal of the Faculty of Science* of Hokkaido Imperial University, Sapporo (Physics, Dec. 1934), there are two interesting papers on snow crystals. The first paper, by U. Nakaya and K. Hasikura, describes 250 photographs of snow and frost crystals they obtained at a sheltered cottage half way up Mount Tokati at an



altitude of about 3,400 ft. The spot was protected from strong winds and very favourable to the formation of large and perfect crystals, the temperature being nearly constant at  $-10^{\circ}\text{C}$ . At this temperature, it was possible to separate some of the crystals into their components and to cut others so as to get good photomicrographs. Some novel shapes were obtained. At Sapporo it was relatively warm and humid, and crystals with water droplets were frequently observed. All the types obtained are classified and ninety-eight large photographs are given showing minute details. The second paper, by V. Nakaya and T. Terada, discusses the electrical nature of snow particles. The authors use an electric deflexion method of measuring the charge. The frequency of occurrence of negatively charged snow was the more common. Sometimes 90 per cent of the crystals were negatively charged. When the crystals had attached water droplets the positive particles tended to be more frequently observed. They were unable to verify when a large snowflake split by mutual friction into large and small portions that the large parts were positively electrified and the small ones negatively electrified. They intend continuing similar measurements on various types of snow crystals next winter.

**Electrical Analysis of Human Language.** Vol. 18, Nos. 3 and 4 of the publications of the Psychological Institute of the University of Milan reports an interesting investigation into the function of human language by means of an electrical analysis, by A. Gemelli and C. Pastori. By electrical apparatus, the oscillographic curves of words and sentences can be recorded, and the writers claim that the laws governing sensory perception and movement are equally applicable to language. Language is a sequence of sound organisations each of which is, by itself, a more or less constant whole. Each word is shown by oscillographic curves to be a whole consisting of different sounds. These sound elements can be investigated separately; but they derive their meaning from the whole of which they are parts, and in turn influence the whole. The same holds for the sentence as a whole. It is also a unit and at the same time a system of words and movements. Various factors influence these movements, and of these melody seems to be particularly important as a means of unifying and totalising. To these unified and organised movements that build up language there are corresponding organisations on the perceptual side: in this way meaning enters and makes understanding of language possible.

**Recombination of Hydrogen and Deuterium Atoms.** Many investigations have been made of the mechanism of recombination of hydrogen atoms with the object of specifying the efficiencies of the third bodies necessary in collisions producing molecules. I. Amdur (*J. Amer. Chem. Soc.*, 57, 856; 1935) has made experiments in which hydrogen or deuterium is dissociated in a Wood discharge tube, and the mixture of atoms and molecules is pumped along a recombination tube with the walls covered with phosphoric acid. Atom concentrations were measured by means of a small platinum catalyst calorimeter which could be lowered to various positions in the tube. In agreement with results of Smallwood, the recombination of atomic hydrogen was found to proceed homogeneously as the result of triple

collisions involving atoms rather than molecules as third bodies, so that the rate equation becomes  $-d[\text{H}]/dt = k[\text{H}]^3$ . An analogous equation holds for deuterium. The values of  $k$  for H and D are  $2.05 \times 10^{16}$  and  $1.51 \times 10^{16}$ , the ratio being  $1.36 \pm 0.06$ . If the diameters and interatomic forces are assumed to be the same for hydrogen and deuterium atoms, the theoretical ratio is 1.41 (that is,  $\sqrt{2}/1$ ). The approximate agreement indicates that the diameters and forces are equal. Viscosity measurements have shown a similar equality of molecular diameters and forces for  $\text{H}_2$  and  $\text{D}_2$ .

**Theory of Groups.** Four recent numbers (194, 195, 198, 205) of the series "Actualités Scientifiques et Industrielles" (Paris: Hermann et Cie., 1935) deal with various aspects of the theory of groups. H. Cartan's "Sur les groupes de transformations analytiques" and E. Cartan's "La méthode du repère mobile, la théorie des groupes continus et les espaces généralisés" deal with Lie's theory; the first from the analytical aspect, the second from the geometrical, using the familiar notion of moving axes. These two pamphlets are written so as to make them intelligible to non-specialists. The other two are on the algebraical side, and make heavier demands on the reader. R. Baer's "Automorphismen von Erweiterungsgruppen" is closely connected with the work of A. Speiser and I. Schur. R. Brauer's "Über die Darstellungen von Gruppen in Galoisschen Feldern" is a continuation of the work of G. Frobenius and L. E. Dickson.

**Airway and Aerodrome Lighting.** The technique of aviation lighting has now reached an interesting stage. Further progress depends on attaining a clearer understanding of what the lights should do and the best way of arranging them. At a joint meeting of the Illuminating Engineering Society and the Royal Aeronautical Society held on March 12, Mr. H. N. Green described some recent developments. A light is said to be 'visible' when the illumination it produces on the eye exceeds a certain minimum known as the threshold illumination. Experiments prove that a light of 0.5 candle power at a distance of one mile can be located without undue difficulty or delay by observers wearing goggles and subjected to local lighting equivalent to that in an aeroplane cockpit. It is known that white light can be recognised more easily when looking slightly away from it; the threshold illumination for 'parafoveal' vision being only one fifth of that necessary when it is viewed directly. A light seen obliquely can be identified when its conspicuity is of the order of 0.1 mile candle. The practical value is taken as 0.5 mile candle. The most important lights are the beacon lights which are placed near the airway to indicate the route. It has been noticed that powerful lights at long range are easier to see in bad weather than lights of less intensity at shorter ranges. The time taken to locate a flashing beacon is partially dependent on the period elapsing between flashes. Experience has led to the use of periods not exceeding five seconds. The beacons required to locate the aerodrome are built up of neon tubes giving 4,000 candles of red light. To identify the aerodrome they flash a Morse signal. This is necessary as the exterior neon lighting of cinemas often exceeds that of a neon beacon. The boundary lights are not yet standardised internationally, but the aerodrome obstruction lights are always fixed and of a red colour.

## Prehistory of Northern Africa

AN important study of the archaeology and racial history of the western area of North Africa, published by the Institut de Paléontologie humaine,\* arises out of the investigation by M. C. Arambourg in the years 1927-30 of a series of caves in the hills which fringe the Gulf of Bougie on the coast of Algeria. Several of these caves were already known to archaeologists and palaeontologists, and finds in them have been described from time to time, but no systematic investigation had been undertaken previously.

The cave of Afalou-bou-Rhummel is a large shelter of ten metres in depth with an opening about twenty metres wide. Its deposits were first examined by trenching along the axis of the cave to a depth of 9.15 m. over a length of 17 metres. The ossuary was found at a depth of between 3.25 m. and 4 m. at about three metres from the south wall. Eight complete skeletons and about fifty skulls were recovered. Another complete skeleton, with the cranium of a child, was found later at a lower level.

The deposits of the cave fall into two sections of which the upper only, reaching to a depth of 7.50 m., contained evidence of human occupation. The lower, archaeologically and palaeontologically sterile, reaches bed rock through a depth of 8 metres.

The upper stratum of the archaeological level to a depth of 4.40 m. contains a uniform industry, of which the chief characteristic is a microlith *à dos retaillé* of the 'La Mouillah' type. The food debris consist almost entirely of marine shells. Below is a deposit 1 metre in thickness in which there is no variation in the industry, but the deposits are of a reddish yellow in colour and the debris of food include some bones of the moufflon in addition to the marine shells. Below this is a sterile layer of 50 cm. thickness which overlies the third archaeological layer of reddish thickly compacted deposits 1.8 m. thick, in which the animal remains constitute a veritable bone bed. Not only was the food-supply of the inhabitants of this period more varied than that of their successors, but also their stone industry, though essentially identical, was more abundant. Below this the sterile layers begin.

The human remains were found in a state of confusion and many of the bones were calcined. The industry of the archaeological levels consists almost exclusively of flint and polished bone-blades, flakes and scrapers. It is virtually identical throughout except that in the upper and later levels there is an increase in the percentage of microliths. Among the molluscs which served as food, *Patella*, *Trochus* and *Helix* are very common, and among the mammalia the dorcas gazelle, moufflon and *Bos primigenius* are frequent.

In the rock-shelter of Tamar-hat, which is now about six metres broad by eight metres deep, but once was much larger, trenching revealed an uninterrupted succession of archaeological deposits of more than five metres depth. Here, also, through a succession of five distinguishable levels, there was what is essentially an identity of industry—again with a predominance in the later stages of the small blades. The vertebrates and mollusca appear in the same

relation as at Afalou, but *Hippotragus* appears here for the first time in North Africa.

Taking into account certain positive and negative characters, M. Arambourg arrives at the conclusion that the industry from the two cave sites is typically Ibero-Maurusian and comparable with that industry as identified on other sites in North Africa in a distribution extending from Morocco to Tunis. As a result of an analysis of the upper palaeolithic stone age of North Africa, he also concludes that the Ibero-Maurusian industry, lying between Mousterian and Mauretian neolithic, is to be considered as a facies of the Upper Palaeolithic, parallel to the Capsian facies, of which it takes the place on the littoral of Constantine, in Oran, Algeria and Morocco. This view is corroborated by the identification of Capsian man and Ibero-Maurusian man, now made possible by the discovery of skeletal remains in the cave of Afalou.

M. Arambourg goes on to wider inference that a similar interpretation is to be placed upon the succession of specialised industries of the Upper Palaeolithic elsewhere, as, for example, in Kenya and South Africa. These, as the Capsian and the Ibero-Maurusian, are to be regarded as specialised and locally evolved Aurignacian.

The skeletal material from Afalou is examined by MM. Boule, Verneau and Vallois. It consists of fifty skulls and nine complete or approximately complete skeletons, of which ten are definitely not adult. All the skulls are robust in type, but, with the aid in certain cases of the indications afforded by the pelvis, 26 men and 14 women can be distinguished among the adults. Thirty-two of the adult skulls are now sufficiently complete for measurement in detail. They present a well-marked type. The cranium is of medium form, the face broad and low, with well-marked glabella and superciliary ridges. The cheek bones and zygomatic arches are massive. There is no prognathism. The maximum length varies from 193 mm. to 206 mm. and breadth from 133 mm. to 159 mm. It will be noted that in breadth they approach that of brachycephalic or mesocephalic peoples of Europe. The mean of the cranial capacity for men is 1,622 c.c., for women 1,456 c.c. Essentially they are dolichocephalic, or mesocephalic, and the sexual difference is insignificant. Evulsion of the upper incisors was practised. Taken as a whole, the remains represent a homogeneous group which, as indicated by the long bones, was of more than average stature. The bones of the skeletons have been subjected to a careful examination, of which the results are described in detail.

As the result of a detailed comparison with the remains of fossil men of palaeolithic age found in North Africa and also with 'fossil' man elsewhere, and more especially with the skeletal remains from Mehta el-Arbi, here studied and described as a complete whole for the first time, the authors conclude that Afalou man approaches most nearly to the Cro-Magnon man and belongs to a North African group, here styled "the Mehta type". This type persists through neolithic, bronze and iron ages and reappears in the population of the Canaries. Though it is possibly to be discerned in the Carthaginian and Roman periods, it appears to have contributed nothing to the modern Berber population.

\* Les grottes paléolithiques des Beni Segoual (Algérie). Par C. Arambourg, M. Boule, H. Vallois, R. Verneau. (Archives de l'Institut de Paléontologie humaine, Mémoire 13.) Pp. 242+22 plates. (Paris: Masson et Cie., 1934.) 180 francs.

## Solar Telescope at Oxford

THE new solar telescope of the University Observatory, Oxford, which was formally declared open by the Vice-Chancellor on June 11, is in its essence a vertical Cassegrain telescope of  $12\frac{1}{2}$  inches aperture and 73 feet focal length. It gives a solar image some eight inches in diameter, and unlike the original tower telescopes (the 60-ft. and the 150-ft. at Mount Wilson) the present instrument is wholly free from chromatic aberration. Further, since the image is formed on the optical axis, the telescope is free from the extra axial aberrations characteristic of horizontal solar reflecting telescopes. Light is fed into the vertical Cassegrain telescope by a 16-in. cœlostat, driven by a synchronous motor, and a secondary mirror of the same aperture. Both cœlostat and secondary mirror are provided with electrical slow motions which are controlled by a portable keyboard near the focal plane of the instrument; the same keyboard also carries controls for focusing the Cassegrain mirror.

The telescope is unique in that it is the only large solar telescope in which all the optical parts are made of fused silica. Since fused silica has a coefficient of expansion  $1/20$  that of ordinary glass, and  $1/7$  that of pyrex, it follows that the differential expansion produced by solar radiation, which tends to make the plane mirrors concave and so to produce an astigmatic image, will be almost wholly avoided in this instrument. The telescope, mounted in the east tower of the observatory on the same pier and under the same dome which housed the De la Rue reflector, was constructed by Sir Howard Grubb, Parsons and Co., of Newcastle, the blanks for the fused silica discs having been supplied by the Thermal Syndicate, Ltd.

On the optical axis of the telescope lies the slit of a large Littrow spectrograph. The spectrograph has two  $60^\circ$  and one  $30^\circ$  prisms of six inches square aperture (height 6 inches, length of face 9.7 inches), and a collimating-camera lens of six inches aperture and some 30 feet focal length. It gives a dispersion at  $\lambda 4200$  of 2.6 mm. per A., and a theoretical resolving power of more than 300,000. The optical parts, supplied by Adam Hilger, Ltd., and a large minimum deviation mount, supplied by C. F. Casella and Co., Ltd., are mounted at one end of a 40-ft. brick tunnel constructed in the basement of the observatory. The spectrograph, which still lacks the essential temperature control for the prisms, the slit end and plate holder mechanism, and a guiding disc, will be completed as funds permit.

In declaring this equipment open, the Vice-Chancellor referred to the chequered history of attempts to establish a permanent observatory in Oxford. No less than three unsuccessful attempts have been made, namely Bishop Fell's failure to persuade Wren to incorporate an observatory in Tom Tower, the establishment of a temporary observatory for Halley in 1704 in New College Lane, and finally the construction of an observatory by the Radcliffe Trustees in 1773, now regrettably, from the point of view of Oxford at least, departing for South Africa. The University Observatory was built by the University some sixty years ago, and the fact that the University has, during a period of exceptional financial stringency, set aside some £3,700 for the purchase of the present equipment may be regarded as evidence both that it desires the present observatory to be a permanent institution, and that it desires to see the study of observational astronomy actively prosecuted at Oxford. The Vice-Chancellor concluded his remarks by expressing the warm hope that some donor, interested in the study of astronomy, would find it possible to provide the relatively small sum needed to complete this equipment.

After the Vice-Chancellor's declaration, and following a period when the instruments were inspected by the assembled company of astronomers, Oxford men of science and other members of the University, the proceedings were concluded by an address by Sir Arthur Eddington on "The Physics of the Sun". Sir Arthur pointed out that the sun may be regarded as composed of three parts, an airy appendage where the atoms are supported by radiation pressure, a middle region where the absorption lines are formed and which is therefore readily accessible for observation with the equipment which had just been inspected, and finally the observationally inaccessible deep-lying interior. While there is a temptation to separate what is observable from what can only be inferred, the creation of such artificial divisions is likely to lead to 'frontier incidents'. The sun is a unit and must be treated as such. Sir Arthur then went on to point out how, in spite of its inaccessibility, it is possible to infer much about the physical conditions in the deep interior, and how such information has been confirmed in a striking way by developments in nuclear physics. In moving a vote of thanks to the lecturer, Prof. E. A. Milne, in a peculiarly happy vein, referred to the many distinguished astronomers and solar physicists who gathered to witness the ceremony and to hear Sir Arthur's masterly address.

H. H. P.

## Interpretation of Spectra

PROF. HENRY NORRIS RUSSELL delivered the George Darwin Lecture to the Royal Astronomical Society at the meeting of the Society on June 14, taking as his subject "The Analysis of Spectra and its Application to Astronomy". Prof. Russell explained that he did not refer to the analysis of spectra in the sense of the analysis of the elements present or absent in a mixture, but to the analysis of the spectrum of each single element.

The history of this analysis goes back to 1883, when it was discovered that the various doublets in the spectrum of sodium possessed the same separation when expressed in wave numbers: Prof. Russell followed the development of this subject down to its rationalisation by Bohr and the introduction of the notion of states of energy which the atom may possess, the frequencies of the spectral lines being given by the familiar quantum relation  $h\nu = E_1 - E_2$ .

Comparatively recently, Hund has given a theory of the way in which the energy states of the atom are built up from the energies of the various electrons in the atom, and there is now a corpus of complicated but definite rules which govern the way in which levels are built up and the restrictions on possible electron jumps, jumps between 'odd' and 'odd' terms, for example, being forbidden. We can now fully understand the structure of even a complicated spectrum such as that of iron.

Turning to the practice of the analysis of spectra, Prof. Russell said that, before one could analyse a spectrum, one needed a list of lines with well-determined wave-lengths, the intensities of the lines, their temperature class (along the lines developed by King at Mount Wilson) and the Zeeman patterns. All the easy spectra have now been unravelled, but a few complex spectra remain to be analysed. Prof. Russell showed a slide exhibiting the present state of completeness of the analysis of the spectra of all the elements. Amongst those which are least analysed are the spectra of gadolinium, terbium, dysprosium, holmium, erbium, thorium, and uranium, while among the lighter elements the spectra of phosphorus, sulphur and chromium are not well analysed.

The astrophysical applications of the newer spectrum analysis were numerous. Saha's relation between the numbers of neutral and ionised atoms present in equilibrium at a given temperature and pressure had given the key to the general interpretation of the stellar spectral sequence. Identifications of lines are made much more reliable when reference is made to the intensity to be expected from the line's place in a multiplet and to the excitation potential of the atom in the state which absorbs the line. Identifications in the far infra-red spectra are particularly

assisted by spectrum analysis, as very accurate wave-lengths are not to be obtained from laboratory measurement: a more accurate separation can sometimes be obtained from a corresponding separation in, say, the green, where good wave-lengths are obtainable. Again, the presence or absence of lines in the solar spectrum receives an explanation based on spectrum analysis. The non-metals do not show strongly, because the lines arising from atomic states with low excitation potentials lie in inaccessible regions of the spectrum. The great majority of apparent variations in abundance between the earth's crust and the solar disc is explained by the excitation potentials of the lines that are available. Only phosphorus, bismuth and radium are truly absent in the sun. Passing on to quantitative analysis, the theory of R. H. Fowler and Milne explained the major features of the spectral sequence, the apparent differences between one spectrum and another being due to differences in surface temperature and surface gravity.

Prof. Russell went on to say that while we recognise that a strong absorption line indicates many absorbing atoms and a weak line few, the detailed physical analysis is difficult. Dr. W. S. Adams and Prof. Russell had calibrated Rowland's scale of intensities—an arbitrary scale—by comparing Rowland's estimates of relative intensities within a large number of multiplets with theoretical intensities, and had applied this to the analysis of a number of stellar spectra. They discovered a departure from thermodynamical equilibrium; but recent work by Struve has thrown doubt on this method of calibration and the departure from thermodynamical equilibrium must now be regarded with caution. Prof. Russell concluded the lecture by referring briefly to bright line spectra and to the spectra of the planets.

### Association of Teachers in Technical Institutions

AT the twenty-sixth Annual Conference of the Association of Teachers in Technical Institutions, which was held at Bournemouth during Whitsuntide, Mr. D. W. Lloyd (Old Trafford Technical Institute, Stretford) was installed as president for 1935-36 by the retiring president, Mr. H. J. Cull (Central Technical College, Birmingham).

In his presidential address, Mr. Lloyd said that during the past twenty-five years two dominant motives have been apparent—the desire to preserve and extend liberty of thought and speech and the desire to mitigate human toil. The first is in the realm of social and political life; the second in the sphere of science and industry. Both, however, have produced effects which are world-wide and touch the sphere of education at every point. To the technical teacher, said Mr. Lloyd, the tremendous changes in our industrial system due to technological development must have special significance. "Magic has entered our research laboratories, scientific advancement and the mechanisation of industry have tended to shorten hours of labour and increased the possibilities for leisure, yet, in our present stage of our development, we are faced with the chaos and misery of unemployment." Rationalisation, he continued, is one of the results of the increasing application of science to industry; but it has produced (by the replacement of as many employees as possible by the minimum

number of machines) the paradox of a world of increasing production in which vast numbers are unable to secure the necessities of life. The machine, however, should not be arrested, since mechanical perfection increases human possibilities, and since the machine can "do the job better than its creator".

Long-range planning in industry and education, however, becomes essential. "The isolation of countries has disappeared . . . geographical barriers are non-existent except to those who think in ancient terms, international wireless communication has no limits unless hampered by those who fear the free movement of thought . . . new industrial contacts are possible; under control they can expand and make friendships. Education in its widest aspects can become an international force, and thus help to replace the narrow spirit of nationalism by the wider appeal of internationalism."

Mr. Lloyd specially stressed the need for liberty of thought. The unrest of the present world, he said, has produced intolerance and the stifling of criticism: in certain cases it has led to the establishment of dictatorial power which must have a reactionary effect on educational progress. Civilisation cannot advance without criticism, and the subjection of the individual will by inhibitions from the outside leads to stagnation and putrefaction. Propositions which may seem obscene, heretical and revolutionary will

get their deserts if openly discussed; but if they are suppressed they will permeate society through insidious channels and do irreparable injury. Freedom to think, freedom to voice one's thoughts within reason, are essential to human progress.

The Conference approved the recommendations of the "Report on Policy in Technical Education" recently published by the Associations of Technical Institutions, Teachers in Technical Institutions, and Principals of Technical Institutions and the National Society of Art Masters. Among other resolutions passed was included one urging the establishment of a system of compulsory part-time day education for all young persons from the age of ceasing compulsory attendance at schools giving full-time education to the date at which the pupil attains the age of eighteen years. The Association reiterated its opinion that the raising of the school leaving age is more than ever desirable. In view of Mr. Lloyd's address, special interest centred about a resolution urging that the conditions of apprenticeship should be restated for the several industries, and that special consideration should be given to the claims of young people who have satisfactorily completed a full-time course in approved technical institutions in respect of the age at which they may be recruited, and the period of time required of them for completion of apprenticeship.

### University and Educational Intelligence

CAMBRIDGE.—Dr. Leslie Harris, director of the Nutritional Laboratory, has been awarded the degree of Sc.D. Dr. Harris is known for his work on vitamins and proteins, and for the latter was awarded the Meldola Medal by the Institute of Chemistry in 1924.

EDINBURGH.—Dr. Otto Samson has been appointed Tweedie fellow for 1935–36 and 1936–37. This fellowship is awarded to enable the holder to carry out exploration and research in the less-known regions of Asia and northern Africa. Dr. Otto Samson was born in Hamburg in 1900, and studied political science and then Oriental languages at the University there. In 1928 he entered the famous Ethnographical Museum (Museum für Völkerkunde) in Hamburg, and in 1930 became head of the East Asiatic Section, a post he held until the Nazi revolution in 1933. In 1931–32 he travelled in China to collect ethnographic specimens for the Museum. In the course of his travels he made an intimate study of the daily life of peasants and craftsmen and of the technical processes employed by them. An examination of the data then collected suggested connexions with India reflected in craft and agricultural processes and their products. It is the extent and direction of the influence of China upon India and vice versa that Dr. Samson now proposes to study.

LONDON.—The Governing Body of the Imperial College of Science and Technology has elected to an Imperial College fellowship Prof. Alfred Fowler, late Yarrow professor of the Royal Society, and emeritus professor of astrophysics in the College.

OXFORD.—The new solar tower telescope was opened at the University Observatory by the Vice-Chancellor on June 11 (see p. 1047).

Sir Peter Chalmers Mitchell (scholar 1884–88), and Prof. N. V. Sidgwick (scholar 1892–96) have been elected honorary students (that is, fellows) of Christ Church.

The course of lectures on the work of early Oxford men of science finished for the session with Dr. R. T. Gunther's lecture at Exeter College. Special reference was made to the work of Borlase on the antiquities and mineralogy, and of Walter Moyle on the ornithology of Cornwall. Of outstanding importance was the advance in the science of geology due to Sir Charles Lyell, while the history of mathematics and astronomy owes much to Prof. Steven Rigaud, whose library was dispersed by the Radcliffe Trustees less than two months ago. Dr. Gunther concluded with a tribute to the biologists, Prof. H. N. Moseley of *Challenger* fame, Sir Baldwin Spencer of Australia and Sir Ray Lankester—all of Exeter College.

THE University of Pittsburgh has conferred the honorary degree of doctor of science on Dr. William A. Hamor, assistant director of Mellon Institute of Industrial Research, Pittsburgh.

MR. H. G. ROBINSON has been appointed principal of the Midland Agricultural College, Loughborough, in succession to the late Dr. T. Milburn. Mr. Robinson, who is a graduate of the University of Durham, is a son of Mr. G. Goland Robinson, a well-known south Westmorland farmer. Since 1929, he has been farm director in the Midland Agricultural College.

### Science News a Century Ago

#### Portrait of Count Rumford

In June 1835, the Managers of the Royal Institution received and accepted from Sarah, Countess Rumford, the portrait of her father, Count Rumford, the founder of the Institution, which hangs now in the Managers' room. The painting, which presents the Count in uniform, is of head and shoulders in profile. It is by an unknown artist, but is believed to be a good likeness. Count Rumford, who died in Paris in 1814, had kept the lease of his house at Brompton, although he had not lived in it for many years. His daughter occupied it again in 1815, and lived there at intervals until 1835. In that year she returned to America, presenting the portrait to the Royal Institution as a parting gift.

#### Roberts's Miners' Safety Lamp

According to *The Times*, on June 23, 1835, a lecture was given to the Eastern Literary and Scientific Institution by Mr. Taylor in the room usually used by the Institution in Hackney Road. "The subject of the lecture was the safety lamp, and the object of the lecture was to show, by actual experiment, that the lamp hitherto used in coal-mines, and invented by Sir H. Davy, is dangerous and insecure, and that a lamp invented by Mr. Roberts is perfectly safe and free from the defects which render the lamp of Sir H. Davy not to be depended on by the miners. Mr. Roberts, who has already received several medals from the Society for the Encouragement of Arts, Manufactures and Commerce, was in attendance and produced the lamp invented by Sir H. Davy and his own lamp, and assisted Mr. Taylor in the lecture and in the experiments."

Roberts's lamp was described as being "surrounded by a double tube of wire gauze, and also by a glass chimney, and is so constructed that a current of carbonic acid air or nitrogen passes continually between the external atmosphere and the flame of the lamp. . . . To comprehend the nature of this invention fully, it is necessary to see the lamp, and compare it with the lamp hitherto used, over which it has certainly a manifest advantage. It is very simple in its construction, and as a committee of the House of Commons are now examining matters of this nature, it will no doubt meet with the encouragement it deserves".

#### London's Water Supply

Commenting on a proposal to supply London with water pumped from wells by steam engines, the *Athenæum* of June 27, 1835, after reviewing the project, said: "The annually decreasing quantity of water in the London bason is also to be remarked. The fall in the level of the wells is, according to credible evidence, about one foot per annum; and there has been a decrease of full twenty feet within the last twenty years. Though this gradual fall is certainly not an object of immediate apprehension, as to the total failure of the supply, yet the infinitely more rapid ratio of decrease which would ensue, if the whole metropolitan supply were taken from the same source, must be obvious.

"For these reasons we have come to the conclusion that though London is supplied with a considerable abundance of the most salubrious well-water for general purposes of domestic use—yet, that to draw upon the bason for the whole of the supplies by means of steam power is, if not objectionable for other reasons, impracticable by reason of the expense of the many divided establishments which must necessarily be required for the production of 20,000,000 galls. per day, which is the generally estimated quantity used in the metropolis".

#### The Hot Blast at the Butterley Iron Works

For some years after the introduction by Neilson of the hot-blast, there was considerable controversy over its merits. One of its advocates was Joseph Glynn, F.R.S. (1799–1863), who was engineer to the Butterley Iron Works, near Derby. In a letter of his published in the *Mechanics' Magazine* of June 27, 1835, he said: "The Butterley Company employ in their mines, coal-fields, blast furnaces, rolling mills, forges, boring mills and steam engine factory, 35 steam engines of all sizes, from 80 inches of diameter of cylinder, and have six blast furnaces, of which four are now at work. The whole of these furnaces are blown with heated air, and the coal, which is admirably adapted for the purpose, needs no cokery, being very carbonaceous. The mountain limestone which lies but three miles from the furnace, is used as flux for the ore, which is clay iron-stone. These materials produce a very fine grained cast-iron, remarkably soft and fluid, and at the same time they are equally well adapted to make 'forge pigs' from which are manufactured bars, hoops and boiler plates, of best quality and steam engines. . . . M. Dufresnoy, M. Perdonnet, and several other Frenchmen of scientific reputation, have visited the Butterley Company's works, with which they have been highly pleased, and have been willing to communicate the valuable information they possess, in return for such as was afforded them here".

## Societies and Academies

### DUBLIN

Royal Irish Academy, May 27. WINIFRED E. FROST: Larval stages of the Euphausiids *Nematoseleis megalops* and *Stylocheiron longicorne* taken off the south-west coast of Ireland. The euphausiids form an important part of the fauna of the inshore and deep waters off the south and west coast of Ireland. The present paper deals with the life-histories of two of these animals, the development of which has not previously been described. Sufficient larval stages have been found to give a good idea of the life-history of the organisms and the descriptions make it possible to identify the larvæ in the plankton. Some notes are given on the reproductive cycles of the two euphausiids.

### PARIS

Academy of Sciences, May 6 (*C.R.*, 200, 1553–1640). LUCIEN CAYEUX: The constitution of the Senonian phosphates of Syria. ALEXANDRE GUILLERMOND: A new fungus, a parasite of the capsules of the cotton plant. *Eremothecium Ashbyii* and its possible relations with *Spermophthora Gossypii* and the Ascomycetes. ARMAND DE GRAMONT and DANIEL BERETZKI: The stabilisation of a frequency of beat (quartz oscillators) by compensation of the temperature coefficients. The method is based on the use of two piezoelectric quartz crystals and different frequencies and determined temperature coefficients. The arrangement is more stable than that utilising a single quartz with low temperature coefficient, and its constancy over a range of 50° C. is equal to a single quartz kept within 0.1° C. HENRI DEVAUX: The adsorption of ovalbumen at the free surface of its solutions when the concentration of these varies from 10<sup>-2</sup> to 10<sup>-8</sup>. GEORGES TZITZÉICA: Some affine properties. IVAN BRAITZEFF: The singularities of special types of a function given by its development in a Dirichlet series. MICHEL KRAWTCHOUK: Some inequalities in the problem of moments. NATAN ARONSAJN: The singularities of the Riemann surfaces of inverse functions of integral functions. HENRI MNEUR: Mechanical systems admitting *n* uniform first integrals and the extension to these systems of Sommerfeld's method of quantification. MIROSLAV NÉNADOVITCH: Contribution to the study in a plane current of rigid biplane cells. RAOUL GOUDEY: Measurements of the intensity of gravity, made in 1933, with the Holweck-Lejay gravimeter No. 2. GEORGES DÉCHÈNE: The discharge rays emitted by a brush discharge. Contrary to the views of Dauvillier, the author's experiments confirm the existence of discharge rays. M. M. QUINTIN: Study of the electromotive force of cadmium chloride batteries. FRANÇOIS CROZE: The general formulæ of the refraction of a light bundle. JEAN PAUL MATHIEU and JACQUES PERRICHET: The rotatory dispersion of the  $\alpha$ -halogen derivatives of camphor. ANDRÉ CLAUDE: Incandescent lamps containing krypton and xenon. A summary of results obtained with more than 10,000 bulbs. On account of the lower heat conductivity of krypton and xenon compared with that of argon the bulbs can be made smaller, a litre of gas filling 20–30 bulbs. The temperature of the filament can be raised, owing to the slower diffusion of the tungsten vapour. JEAN PERREU: The tonometry of saline solutions. PAUL ABADIE and GEORGES CHAMPETIER: The determination of some dielectric

properties of heavy water. PAUL GOLDFINGER, WLADIMIR LASAREFF and MORICE LETORT: Thermochemical considerations on the carbonyl group. PIERRE SPACU: A method for the quantitative separation of iron and cobalt. The ferric iron is precipitated by pyridine and the cobalt in the filtrate precipitated as the ammine  $\text{CoPy}_4(\text{SCN})_2$ . MARCEL PATRY: The properties of allotelluric acid. MARCEL GODCHOT, MAX MOUSSERON and ROGER RICHAUD: The  $\Delta_2$  and  $\Delta_3$  1-methylcyclopentenes and their derivatives. V. M. MITCHOVITCH: The action of *o*-chlorocyclopentanone on the organomagnesium halides. FIRMIN GOVAERT: The use of liquid hydrogen chloride in the preparation of the dichlorarsines. JEAN LAVAL: The diffraction of X-rays by the silver atom (factor of structure). HENRI LONGCHAMON: The chemical formula and constitution of Ampandrandava sepiolite. JEAN ECK and JEAN MENABREA: The arrangement of the faces of the trihedra obtained by the corrosion of a plate of quartz. JOSEPH BLAYAC, RODOLPHE BÖHM and GASTON DELÉPINE: A new Goniatite fauna in the Viséan of Montagne-Noire. H. BESAIKIE, P. GRUYELLE, A. LENOBLE and A. SAVORNIN: The geological and magnetic study of the cliff of Mandraka (Madagascar). V. FROLOW: The general characters of the changes of level or of flow. ALBERT MAIGE: New observations on the evolution of the amylogen plastids in the reserve starch cells. WLADYSŁAW ANTONI BECKER and FRANÇOIS XAVIER SKUPIENSKI: Vital protoplasmatic observations on *Basidiobolus ranarum*. ROBERT BONNET and RAYMOND JACQUOT: The variation of the velocity of growth and of respiration in *Sterigmatocystis nigra* and of the crude energy yield, as a function of the age of the cultures and the source of nitrogen. CAESAR R. SCHOLZ: The constitution of corynanthine. RENÉ SOUÈGES: The embryogeny of the *Cenotheraceae*. The principal terms of the development of the embryo in *Ludwigia palustris*. ROBERT WEILL: The structure, origin and cytological interpretation of the colloblasts of *Lampetia pancerina* (Ctenophores). RAOUL HUSSON: The rôle of the laryngeal apparatus in the formation of the timbre of spoken and sung vowels and the genesis of the changes of compass and registers of the voice. MME. VÉRA DANTCHAKOFF: Endocrinian proliferations at the expense of the germinative epithelium. RENÉ AUDUBERT and ROBERT LÉVY: The emission of radiation by nerve stimulation. MICHEL FAGUET: The photometric diagnosis of the Eberth bacillus, of para A and of the coli bacillus. The photometric method of measuring the rate of increase described in a previous note has been applied to twelve strains of coli, eleven strains of the Eberth bacillus and six of para A. Each gives its characteristic curve and the photometric diagnosis agrees with the bacteriological diagnosis. GASTON RAMON and EDOUARD LEMÉTAYER: The reinforcement of the immunising action of toxins and antitoxins. The method is based on coating the toxin or anatoxin with lanoline.

## COPENHAGEN

Royal Danish Academy of Sciences and Letters, February 1. G. HEVESY: Artificial radioactivity of scandium. When scandium is bombarded with neutrons, the product is partly a radioactive isotope of potassium, and partly a radioactive isotope of scandium, the former emitting hard, the latter soft  $\beta$ -rays.

March 1. L. KOLDERUP ROSENGE: Some Danish Phaeophyceae. The development of the two

species of *Stictyosiphon* occurring in Danish waters (*S. tortilis* and *S. soriferus*) has been examined, the germination of the zoospores from the plurilocular sporangia having been observed, in both cases apparently without fusion. In both species a filiform, branched, creeping protonema was produced on which an erect shoot appeared, bearing plurilocular sporangia, just as the mother plant. An alternation of generations therefore does not take place. The morphology of the Danish members of the family Elachistaceae was discussed.

## GENEVA

Society of Physics and Natural History, May 2. FERNAND CHODAT: Tyrosinase and glutathione. The experiments carried out prove that glutathione completely inhibits catalyses determined by tyrosinase on tyrosine, *p*-oxyphenylethylamine and the system *p*-cresol-glycocol. The inhibiting rôle of glutathione in melanogenesis *in vivo* is considered. FERNAND CHODAT and ANDRÉ MIRIMANOFF: The ageing of yeasts. *Endomyces anomalus* is studied from the point of view of its respiration. The ageing consists in leaving fresh yeasts, in buffer solutions of phosphate, with or without sugar at different temperatures. The respiratory power is measured with Warburg's apparatus under these different conditions. G. TIERCY: (1) Remarks on the differential equation of the second order met with in cases of polytropic equilibrium of gaseous spheres. The paper discusses the examination of an energy hypothesis utilised by Biało-brzeski and by Eddington. (2) The general differential of the second order characterising the thermodynamic equilibrium of gaseous spheres. This equation is complicated; it is always simplified when the case of polytropic equilibrium is considered.

## LENINGRAD

Academy of Sciences (C.R., 1, No. 9, 1935). D. PEREPÉL'KIN: Parallel varieties in a Euclidian (or Riemannian) space. L. SCHIEFNER: The *m*-th power of a matrix. G. KRUTKOV and V. DMITRIEV: Contribution to the theory of Brownian movement. Small fluctuations of a system with *n* grades of freedom. D. VOLKOV: An exact solution of the Dirac equation for a flat wave of definite frequency. E. ANDREJEV: Influence of a metallic surface on the kinetics of oxidation of ethane. K. LJALIKOV, I. PROTAS and G. FAERMAN: Displacement of the isoelectric point of gelatine. V. IPATEV and V. TRONEV: Mechanism of displacement of noble metals in solutions of their salts by hydrogen under pressure. (1) Displacement of palladium in solutions of palladium chloride. (2) Displacement of metals in the solutions of  $\text{H}_2\text{PtCl}_6$ ,  $\text{H}_2\text{IrCl}_6$ ,  $\text{Na}_3\text{IrCl}_6$  and  $\text{Na}_3\text{RhCl}_6$ . O. ISTOMNA and E. OSTROVSKIJ: Effect of super-sonic vibrations on potato growth. K. SUKHORUKOV and T. EPEL-BOGOSLOVSKAJA: Action of bios on processes of putrefaction. V. SHARONOV: Daylight illumination under different conditions. A. LABUNCOV: Age of uraninite and monazite from the pegmatite veins of northern Karelia. I. ALIMARIN: Chemical constitution of tshvekinin. DONTCHO KOSTOFF: Studies on polyploid plants. (10) The so-called 'constancy' of the amphidiploid plants. G. MELLER and A. PROKOFJEVA: Structure of the chromonema of the inert region of the X-chromosome of *Drosophila*. V. KATUNSKIJ: Growth-promoting substance as a factor in the formation of the plant organism. V. CIVINSKIJ:

Critical period of the cotton plant. L. POLEZHAYEV : Restoration of the regenerative power in tailless amphibians (2).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 143-180, March 15, 1935). JAN SCHILT : Preliminary note concerning a new theory of the motions of the stars. The parallaxes of stars of spectral type *A* are used to give rectangular equatorial velocity components, and an expression is derived from which other parallaxes have been derived satisfactorily. The formula incorporates the hypothesis of an expanding stellar system. HARRIET B. CREIGHTON and BARBARA MCCLINTOCK : The correlation of cytological and genetical crossing-over in *Zea mays* : a corroboration. Chromosome 9 in maize is characterised by the 1 : 2 ratio in length of its two 'arms' ; in some strains the shorter arm carries a large knob, whereas in others it is small or absent. This knob has been used as a cytological 'marker'. FRANK H. CLARK : Two hereditary types of hydrocephalus in the house mouse (*Mus musculus*). The character is a simple recessive. Since mice with water-on-the-brain are sterile or transit only a low grade of this affection, heterozygous animals were used. When such animals of two strains, one from Michigan and the other from Berlin, were mated, the offspring contained no hydrocephalics, indicating that two different genes are involved in the two strains. TORSTEN TEORELL : Studies on the 'diffusion effect' upon ionic distribution. (1) Some theoretical considerations. Study of an aqueous system of strong electrolytes where steady diffusion across a boundary permeable to ions takes place. The theory predicts a distribution of ions similar to that for non-diffusible ions indicated by the Gibbs-Donnan equilibrium, which appears as a limiting case of the general theory discussed. Great concentration differences such as occur in biological systems are theoretically possible. H. S. VANDIVER : On the foundations of a constructive theory of discrete commutative algebra (2). J. LEVINE : Conformal-affine connexions. OSWALD VEBLEN : Formalism for conformal geometry. H. BATEMAN and S. O. RICE : Some expansions associated with Bessel functions. ROBERT W. WILSON : *Simimys*, a new name to replace *Eumysops*, Wilson, preoccupied : a correction.

### Forthcoming Events

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

Sunday, June 23

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.  
Miss M. Smith : "Reptiles and Fossil Reptiles".\*

Monday, June 24

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Annual General Meeting.

BRITISH WATERWORKS ASSOCIATION, June 25-29. Annual General Meeting and Conference to be held at Cambridge.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, June 26-29. Annual Congress to be held at Bournemouth.  
Prof. A. C. Seward : "The Herbarium of the Rocks" (Presidential Address).

### Official Publications Received

#### GREAT BRITAIN AND IRELAND

The Scientific Journal of the Royal College of Science. Vol. 5 : Containing Papers read during the Session 1934-1935 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 138. (London : Edward Arnold and Co.) 7s. 6d. net.

Report of the National Baby Week Council 1934, presented and adopted at the Eighteenth Annual Meeting of the National Baby Week Council held in London on the 27th March 1935. Pp. 24. (London : National Baby Week Council.)

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1935. Pp. 63+6 plates. (Edinburgh : Zoological Society of Scotland.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 25 : On the Characteristics of *Bacterium violaceum* (Schröter) and some Allied Species of Violet Bacteria. By George Cruess-Callaghan and M. J. Gorman. Pp. 213-221+1 plate. (Dublin : Hodges, Figgis and Co.; London : Williams and Norgate, Ltd., 1935.) 1s.

The Men of the Trees. Tenth Year's Report and Review of the Tree Year 1934. Pp. 39+4 plates. (London : Men of the Trees.) 6d.

Right and Might : an Argument for an International Police Force. By Alan Burnett Rae. (Series B, No. 7B.) Pp. 18. (London : The New Commonwealth.) 3d.

The Strangeways Research Laboratory, Cambridge. Report for 1934. Pp. 26. (Cambridge : Strangeways Research Laboratory.)

Department of Scientific and Industrial Research. Report of the Chemistry Research Board for the Period ended 31st December 1934 : with Historical Introduction and Report by the Director of Chemical Research. Pp. v+94. (London : H.M. Stationery Office.) 1s. 6d. net.

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Fourteenth Annual General Meeting on May 28th, 1935. Pp. ii+66. (London : Empire Cotton Growing Corporation.)

Report on the Fisheries of Palestine. By James Hornell. (Published on behalf of the Government of Palestine.) Pp. 106. (London : Crown Agents for the Colonies.) 7s. 6d.

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1935, June 1. Pp. 24. (Greenwich : Royal Observatory.)

The Institution of Gas Engineers. Communication No. 107 : 72nd Annual Report and Accounts of the Council of the Institution of Gas Engineers to be presented at the 72nd Annual General Meeting to be held at the Institution of Civil Engineers, Great George Street, London, S.W.1, on the 4th, 5th and 6th June 1935. Pp. 39. (London : Institution of Gas Engineers.)

#### OTHER COUNTRIES

Indian Central Cotton Committee : Technological Laboratory. Technological Bulletin, Series B, No. 19 : Effect of Storage prior to Ginning on the Spinning Quality of Cotton. By Dr. Nazir Ahmad. (Pp. 13). (Bombay : Indian Central Cotton Committee.) 8 annas.

Canada : Department of Mines : Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1933. (No. 744.) Pp. iv+194. (Ottawa : King's Printer.)

Scent and the Weather. By Flight-Lieut. R. G. Vervard. (No. 1935/3.) Pp. iv+33+5 plates. (Chaman, Baluchistan : The Masters of Foxhounds Association of India.) 3 rupees.

Studies from the Connaught Laboratories, University of Toronto. Vol. 6 : 1933-1934. Pp. vii+78 papers. (Toronto : University of Toronto Press.)

Survey of India. General Report, 1934, from 1st October 1933 to 30th September 1934. Pp. vi+73+11 plates. (Calcutta : Survey of India.) 1.8 rupees ; 2s. 6d.

India Meteorological Department. Scientific Notes, Vol. 6, No. 61 : Evaporation in India calculated from other Meteorological Factors. By P. K. Raman and V. Satakopan. Pp. 51+6 plates. (Delhi : Manager of Publications.) 1.12 rupees ; 3s.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 119 : Buckling and Failure of Thin Rectangular Plates in Compression. By Mineo Yamamoto and Kazuo Kondo. Pp. 22, 25 sen. No. 120 : Further Studies on the Effect of the Ground upon the Lift of a Monoplane Aerofoil. By Susumu Tomotika. Pp. 23-44, 25 sen. (Tôkyô : Kôgyô Toshô Kabushiki Kaisha.)

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