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Science in Social Problems

IT has continually been urged in these columns that an organised endeavour should be made to link up scientific knowledge with appropriate action in social, economic, and national affairs. Sir Alfred Ewing's presidential address to the British Association at York indicated the extent to which scientific workers are now concerned with the social consequences of their discoveries. At the present moment the disorganisation in the world's economic and distribution system, with the resultant widespread industrial depression and unemployment which has resulted from the advent of power production, is perhaps uppermost in our minds. The dangers which threaten civilisation through its failure to make a rightful use of the enormously increased productive powers with which mechanical science has endowed it, are by no means the only threat which the gap between scientific advance and moral or ethical development offers. The fourteen years which have passed since the War have, as yet, brought no check to the prostitution of scientific effort to destructive purposes. Far more destructive weapons are now available, and a repetition of the calamity of 1914 may well threaten the extinction of civilisation. As yet, however, neither scientific workers nor any other section of the community has succeeded in calling any real halt in armaments, or in inducing the Governments of the world to base their policies upon the obvious fact that the renunciation of war as an instrument of national policy is a fundamental condition of the security of civilisation.

These are major matters, but equally in lesser issues is it true that the enjoyment of the benefits of applied science involves the renunciation of deeply embedded habits and prejudices. The same forces which can minister so abundantly to our resources, our pleasures, our health, our enjoyment of life, can become a most serious public danger in the hands of careless, indifferent, or selfish individuals. The possibilities of the abuse of power increase with its magnitude in the same proportion as the possibilities of its beneficial use, but while use is dependent on knowledge, abuse is as possible in the hands of the ignorant and thoughtless as it is in those of the deliberately selfish or morally perverse.

The realisation of these conditions, coupled with the backward condition of the so-called social sciences, has already led many scientific workers and others to sound a warning note. Sir Alfred

Ewing's assertion that man was ethically unprepared for the great bounty of the engineer, that in the slow evolution of morals he was still unfit for the tremendous responsibility it entailed, and that the command of Nature had been put into his hands before he knew how to command himself, found support at the British Association meetings in the subsequent address of Prof. Miles Walker to the Engineering Section.

Prof. Miles Walker referred to the way in which vested interests blocked the way to improvement, and unintelligent control and stupid prejudice preserved the old evils, refusing to be convinced, long after science had shown the way to make things better for the people. The persistence of atmospheric pollution, mainly through domestic smoke, with the attendant loss of sunshine, and waste in dirt, health, and valuable by-products, the waste of heat and power, the paralysing influence of the middleman on the grid system —these are familiar examples of the way in which prejudice and selfishness react against the general welfare and prevent the utilisation of the benefits of applied science. Prof. Miles Walker proceeded, however, to emphasise the contribution which the engineer and man of science could make in economic and social matters, also towards the amelioration of the lot of mankind. Asserting that knowledge must form an essential qualification for executive office in the modern State, and was indeed the only sound basis for action, he suggested that in a small self-supporting State under the control of men of science it might thus be possible within a few years to demonstrate the high standard of life obtainable by modern organisation and modern methods. But as Sir Josiah Stamp remarked in a discussion in the Section of Agriculture dealing with the distribution and marketing of agricultural products, we need the moral rectitude of a Joseph, as well as his economic prudence, in planning under the conditions of to-day.

The direct outcome of the presidential address to the Engineering Section was a resolution passed by the Section expressing its conviction that the present world depression indicates that the machinery of government and finance is inadequate to deal with the vastly increased productive capacity of peoples brought about by the application of science, and the further opinion that the present economic position of Great Britain calls for far wider co-operation between the scientific community and the Government. The resolution urged the Government to invite the leading scientific institutions and societies to appoint in conference representatives to co-operate with the Government to formulate plans for dealing with the present problems facing the country.

The desire of the promoters of the resolution, however, to gain the assent of the whole of the British Association was disappointed, as when the resolution came before the Committee of Recommendations, it was turned down by a large majority. The resolution will accordingly not be passed on to the Council of the Association for adoption, although of course the Council could itself take independent action if it wished, without any suggestion from the Committee of Recommendations. It is perhaps not surprising to find that representatives of science present at the York meeting are not actively interested in the social consequences of scientific progress. Science is so specialised to-day that workers in any one branch of science are liable to have their attention so concentrated upon their own particular subjects that they see little of the field around them, and are unconcerned in its general activities or problems. The representation at the British Association meetings is still largely academic, and it may be hoped that, as the industrial element in the attendance increases, the interest in the social consequences of scientific discoveries may grow stronger.

Since the British Association has failed to take action, it is possible that the British Science Guild, which was founded in 1905 "to promote the application of scientific method and results to social problems and public affairs", may be induced to make some definite proposals for bringing scientific work and thought to bear upon social problems. At least some effort might be made to secure wider support for the task the Guild has undertaken of compiling a volume which will indicate the value of the contributions science has already made to our national progress, and the potentialities of science in the evolution of a better order of society.

Apart from Prof. MacDougall's eloquent appeal in Manchester last year for research into the social sciences, and the discussions at the centenary meeting of the British Association, there have not been wanting other similar proposals. Some time ago, Dr. G. E. G. Catlin, professor of politics in Cornell University, outlined a scheme for the formation of a social science research council in Great Britain, covering all social fields of scientific study and scientific fields of primary social relevance. The council would not only act as a clearing-house of information on scientific work in social sciences, and provide a means of obtaining competent repre-

sentatives of the social sciences on other national bodies, but would also act as a controlling organisation to which the Government could turn to sponsor independent and impartial research into social and economic problems. It was not proposed that the council should directly undertake research, or even become a mechanism for co-operative research, although the supervision of specific pieces by *ad hoc* committees might come within its scope. It was rather suggested that the council would provide a source of disinterested expert advice on social matters, which is indispensable in national planning, but is not satisfied by the Economic Advisory Councils hitherto appointed.

If it is disappointing to find that the British Association itself was unwilling to take up the suggestions made at the York meeting, it is at least encouraging that the responsibility of the man of science in these matters has been publicly admitted before such a representative gathering. It is to be hoped that the suggestions may be crystallised by some other organisation into concrete and practical proposals which can be put before the scientific community as well as the community in general. When this has been done, the disposition of the ordinary citizen at the present moment to reflect that the application of the dispassionate temper of science to the difficulties of the hour might facilitate their settlement, should encourage the scientific worker to shoulder his responsibilities of leadership, of his capacity for which discussions at the recent British Association meetings on such matters as water supply, water pollution, the planning of markets, and the prevention of disease in animals furnished copious evidence.

The Alps and the Alpids

(1) *Diskordanz und Orogenese der Gebirge am Mittelmeer.* Von Prof. Dr. Wilfried von Seidlitz. Pp. xxiv + 651 + 14 Tafeln. 72 gold marks.

(2) *Das alpine Europa und sein Rahmen: ein geologisches Gestaltungsbild.* Von L. Kober. Pp. iv + 310 + 3 Tafeln. 20 gold marks.

(Berlin: Gebrüder Borntraeger, 1931.)

THESE two works are both by geologists who have spent many years of field work studying the tectonics of the most recently folded belt of the earth's crust. They are concerned with the same subject and, whilst they are completely different in style and at first sight not much alike in conclusions, they have one feature in common. This is that the tectonics of the Alps are not the normal Alpid tectonics. The Alps are a special and unique portion of the great Tertiary fold-belt of the Alpids. West Alpine geologists, fascinated by the spectacular nappe-displacements of their own mountains, have over-emphasised, quite naturally, the importance of similar structures in the remainder of the Alpid chains. The authors of these volumes are, as it were, seeking for a new point of view from which the Western Alps will appear in their proper perspective. They show that the history of the Alpids is more than a history of young folded chains, since the reaction of tectonic islands of old folded masses, thrust-tectonics of marginal regions, fracturing, torsion movements between earth-blocks, their rising and sinking, and the associated seismic and volcanic phenomena, are all of fundamental importance in the architecture of the mountain zones. Termier's shout of 1904, "Rien n'est en place, il n'y a que des nappes", appears with respect to its second half to be a somewhat premature expression of enthusiasm.

(1) The first part of von Seidlitz's book is concerned with general matters affecting the origin of the present Mediterranean region. Morphology, palæogeography, and igneous geology are considered. The importance of median masses (*Zwischengebirge*), as a sort of tectonic islands, and their contrasts to central massifs are examined. Old tectonic kernels, relics of pre-Mediterranean orogeny, have acted as obstacles in the path of the younger folding. The divisions of the orogenic belt are developed, whilst the great importance of fractures and torsional phenomena is emphasised. The correlation of seismic and volcanic happenings with tectonic events, dealt with in detail in the first part, is stressed throughout the book, and is illustrated by many of Sieberg's seismic maps.

In the second part there are given detailed tectonic analyses of the different Mediterranean regions. This part concludes with a discussion of the many syntheses of the Mediterranean Alpids—those of Suess, Termier, Kober, Staub, Stille, and Jenny—after which von Seidlitz develops a synthesis of his own. This depends chiefly upon the recognition of main and subordinate geosynclines and of two orders of median masses.

In the third part of the book an account is provided of the whole Mediterranean orogeny. Nine tectonic zones make up the complete belt. In the centre run the folds of the main geosyncline—Sierra Nevada-Corsica-Alps-East Dinarids-Taurids; this is flanked on either side by the inner median masses, followed outwards by the folds of the subordinate geosynclines, these by the outer median masses, and finally the folds of Jura type next the

forelands, giving nine zones in all. But this picture is complicated by the torsional structures caused by northward push in the western part of the Mediterranean and a southward push in the eastern part. As a result, great fracture zones run north-west and south-east, chief of these being the Ægean, Ionian, and Balearic.

(2) Kober's style is completely different from that of von Seidlitz. It is comforting but unusual to find a scientific work in German, or for that matter in any language, in which the majority of sentences have no more than six to a dozen words. This machine-gun, Bart Kennedy style, reinforced by simple diagrams and innumerable summaries, makes Kober's exposition of his views exceedingly clear and attractive.

In his "Der Bau der Erde", Kober developed the bilateral theory of orogeny, in which fold-mountains are considered to be produced by the approach of two rigid portions of the crust, with the consequent over-thrusting of the median portion upon the two advancing blocks. On this theory, a descendant of Elie de Beaumont's 'jaws-of-a-vice' theory, the northern stem of the Alpid chain is thrust northwards on to Europe, and the southern stem southwards on to Africa. In this present work, Kober develops the theory in greater detail. He classifies each orogenic stem into the Externids (for example, the Helvetids of the Alps), the Metamorphids (for example, the Penninids), the Centralids (for example, the Austrids or East Alpine nappes), and the Internids. The last form the median masses or *Zwischengebirge* and show basin range structures. From the Alps, these zones are traced throughout the whole of the Alpid fold-mountains of the Mediterranean region. The importance of the pre-Gosau movements is constantly stressed. The last half of the book deals with general questions, such as the application of Kober's divisions of the orogenic belt to the Variscan folding of late Palæozoic date, the time-sequence of events in the Alpid folding, and comparisons and results. In this section some excellent tilts at the geophysicists will cheer all field geologists.

A comparison of Kober's present synthesis with that given in his "Der Bau der Erde" of 1928 shows little change except in the western Mediterranean. The Celtiberian chains are now outside the main Alpid arcs, the Betic cordillera being joined through the Balearics to Sardinia and Corsica. Further, a comparison of the results of Kober and von Seidlitz shows a surprisingly large amount of agreement, in spite of the great difference in treatment and outlook of the two authors. Both books are works of first-class importance to all students of tectonic geology.

The typography of these books is excellent, the misprints are exceedingly few, and the diagrams, plates, and illustrations uniformly good. Von Seidlitz's book is equipped with a fairly comprehensive index, but, as in the case of "Der Bau der Erde", Kober is satisfied with an extended list of contents—a blemish in books of this size and diversity. H. H. R.

Creative Man

The Emergence of Man. By Gerald Heard. Pp. 303. (London and Toronto: Jonathan Cape, Ltd., 1931.) 10*s.* 6*d.* net.

THIS new book of Mr. Gerald Heard is a welcome sequel to the earlier one on the "Ascent of Humanity", which was noticed in NATURE of Aug. 9, 1930, p. 196. It is an advance upon it, because it deals more specifically with the known facts of history, and is for that reason more easily grasped by the person of average literary education and more likely to influence such a reader in the direction of co-ordinating his scattered fragments of historical knowledge. We welcome it specially because the author appreciates in a general way, and with enthusiasm and confidence, the rôle of science in building up civilisation, and leaves us in the last pages, if somewhat breathless, at least not prostrate. The richness of our discoveries and the glory of the prospect now revealed to us in the future by the action of man's mind, directed by science, cannot mean that civilisation is bankrupt and that we are standing on the brink of a moral and economic precipice. *Possunt quia posse videntur.*

The criticism which occurs is therefore not destructive but complementary; one would like the thought more completely worked out on its own lines. These lines are fundamentally sound, and often enlightening and suggestive of further thought in the same direction; but it would be a serious illusion, and sometimes a positive error, to rest in the brilliant impressions thrown out, especially in the earlier and more speculative portions. Thus it is constantly suggested that the primitive man is bursting with new ideas; life and thought are 'emerging'; a flash comes which creates an epoch; and so on. What one feels most strongly in reflecting on the—to us incomparable—slowness of the evolution in these prehistoric millennia, is the subtle and imperceptible way in which the steps must have been achieved.

Mr. Heard gives us vivid pictures of the way in

which the pre-humans drove off their first lion, made their first fire, and drew their first magic bison on the cave-wall. It is all perfectly legitimate imagination and brightens up the story charmingly, but one is quite sure that actually the process was stumbling, painful, many times repeated, and approached at a hundred different angles. It is for this reason, among others, that it pays us better to study as profoundly as possible the documents and monuments which we possess to see what they tell us of the minds of the men and the society from which they sprang. Such was the patient work of Tannery on the science of the Greeks, and the same method is now being applied to the remains of ancient Egypt, which Mr. Heard assumes unquestioningly as the nursery of civilisation.

One example drawn from this field will illustrate the difference. The pyramids, says Mr. Heard, have been treated as the work of wretched slaves toiling under the taskmaster's whip. No whip could have done the marvel; the compulsion was a spell, an urge of magic. Here we have a sound criticism and a sound suggestion of another motive at work, but it is incomplete and does not touch what, from the point of view of permanence and constructive power, is the most important aspect of pyramid building. This surely is the attainment, at that age, of accuracy in measurement and in collective working which within its limits could not be surpassed. Here are two fundamental factors in the building, not only of pyramids, but also of the whole structure of science.

A similar criticism occurs when we read Mr. Heard's account of the Romans. He finds the Roman world "hardly creative at all", which seems a strange judgment when we reflect that the Roman world, consolidating the work of the Greeks, is the one social and legal structure which has survived the ages, and that we are still living in it. It is true, of course, that they were not creative in that sense of flashes of genius which bring new things ready-made into the world. But in the other sense, of fitting things together and making men work together, they were far greater builders than the Pharaohs of the pyramids. This is an essential part of the scientific organisation of society.

One third and last point before we resign ourselves to the pleasure of reading the book again and recommending others to do the same. Mr. Heard is inclined in the latest period again to underestimate the validity of the structures of thought and of social organisation which science has built up. He sees Bolshevism as the new settlement of the world which is likely to spread, though that is only using science at its own dictation and for its own ends. Revolutionists do not really desire or respect science, as witness the treatment of Lavoisier by the Convention. But this was an exceptional incident, possible only in time of acute political passion. We cannot argue from it, or from the Bolshevists' attitude to their own men of science. The whole world, now represented outside Russia by the League of Nations, has been brought together, and is now—with some halts and spasms—functioning as a whole, through the spread of science. Why should we be always assuming that the Bolshevists are bound to be too strong for us? It is a curious fact that people who do that never mention the League of Nations, and Mr. Heard is no exception to this rule.

However, the book as a whole is fresh, suggestive, and delightful, and one may hope it will stimulate both Mr. Heard and others to similar studies.

F. S. MARVIN.

Quantitative Pharmacology

Bioassays: a Handbook of Quantitative Pharmacology. By James C. Munch. Pp. x + 958 + 6 plates. (London: Baillière, Tindall and Cox, 1931.) 45*s.* net.

THE author has reviewed in this volume all the more important papers published to the end of 1929 which deal in a quantitative manner with the effects of drugs upon the body. That the task has been laborious is shown by the fact that more than 200 pages, nearly a quarter of the book, is devoted to the bibliography. The author hopes that his work will prevent duplication of effort in the future: it is certainly worth recommending investigators to consult it before commencing a research, both for methods available and also for results already obtained, either with the drug under examination or with those of similar composition or action.

Following short sections on technique and the interpretation of results, come chapters dealing with the drugs affecting the nervous system, the circulation, respiration, and the muscles. The last two are devoted to glandular products and a miscellaneous group of special drugs, which includes antisyphilitics, antitoxins, and the vitamins.

In a work of this character, some unevenness of treatment is bound to occur: for example, the assay of the extract of the posterior lobe of the pituitary gland is described fully enough to enable an investigator to perform the test without further reference to original work. With insulin this is not the case; a number of methods are briefly referred to, but only general indications as to the

most suitable are given, and even then the details are not sufficient to enable the investigator to carry out a test without reference to the original papers.

A more fundamental criticism may be made. Sufficient distinction does not seem to be made between tests carried out without the use of a standard and those in which such a standard is employed. It might be convenient to confine the term 'bioassays' or 'biological assays' to the latter; 'quantitative pharmacology' would then have the wider significance. Owing to the different responses which different animals of the same species give to the same dose of a drug, it is not always easy to duplicate results at different times or in different laboratories, even when large numbers of animals are employed. The use of a standard of reference enables comparable results to be obtained in different tests, since it prevents unavoidable variations in technique or in animal sensitivity from affecting the final result. For this reason, emphasis might be laid on the greater accuracy of those assays which have been carried out against a standard of reference. However, the book may be thoroughly recommended to all pharmacologists and others interested in the biological examination of drugs, of both vegetable and animal origin.

Telegraphy and Television

From Telegraphy to Television: the Story of Electrical Communications. By Lieut.-Col. Chetwode Crawley. Pp. xii + 212 + 24 plates. (London and New York: Frederick Warne and Co., Ltd., 1931.) 6*s*. net.

THE author's declared intention of giving "a bird's-eye view of telegraphy and telephony in all their branches, showing their history, development, attainments, and future possibilities", is not quite satisfactorily fulfilled in this volume. Full weight must be given to the difficulties of presenting, in two hundred pages of simple language, a clear story of the spectacular growth of electrical communications. Yet, full weight given, the present result is a little disappointing. The need for simplicity brings with it the danger of superficiality, and the treatment tends to be somewhat patchy, especially in the later chapters.

The hobby-horse is a poor mount on which to lead a pageant of history. There are two interlinked topics running through the volume which the reviewer finds peculiarly irritating. One is the general theme expressed, for example, in this comment on Hughes's experiments: "Orthodox science had closed the door on the invention of wireless telegraphy as it has so often attempted to do in the case of other important inventions". The other is the presentation of television in a way which fails to give the reader any estimate of the true technical and æsthetic position in television to-day. The author adds to the many disservices which television in Great Britain has already suffered at the hands of its friends by devoting much of the chapter headed "Television" to a series of quotations which will make the reader ask why it should be necessary to reassert with such iteration Mr. Baird's claims to priority. The topics are, as has been said, interlinked, as, for example, by the *obiter dictum*, "Marconi, like Baird to-day, was not in the least perturbed by the opinions of the most eminent physicists or anyone else".

To suggest, as these two quotations do, that there is any valid analogy amongst the three cases of Hughes, Marconi, and Baird, is to embark on a subject which cannot be left as the author has left it. Hughes—to whom the author does less than justice—was certainly the victim of a pontifical conservatism of the most unhappy kind. Marconi—whose special contribution to electrical communications the author states very fairly—received very generous encouragement from many practitioners of "orthodox science". The encouragement was very mildly tempered by a legitimate warning about the difficulties suggested by diffraction theory, a warning which he rightly put to the test of an experiment, the success of which greatly widened the boundaries of orthodox science. Baird—to whom the author does perhaps a little more than justice—has been warned by "eminent physicists" and workers in "orthodox science" (1) that there is more than one way of approach to television and (2) that the laws of physics do not allow him to give an æsthetically satisfactory service in the particular band of medium frequencies allotted to him under the laws of man. This is a very tenuous basis for the "atmosphere of captious criticism" which the author detects around television.

The final chapter of personal reminiscences, from one who has been in exceptionally close contact with the whole life-history of wireless telegraphy, is most interesting and entertaining. The book as a whole is interesting. The remarks already made prove that it may fairly be described as stimulating; the twenty-four plates make a substantial contribution to the picture which the author sets out to draw.

Short Reviews

Organic Syntheses. Collective Volume 1. Being a revised edition of Annual Volumes 1-9. Editorial Board: Henry Gilman, Editor-in-Chief; Roger Adams, J. B. Conant, W. H. Carothers, C. S. Marvel, H. T. Clarke, C. R. Noller, F. C. Whitmore, C. F. H. Allen, Secretary to the Board. Pp. ix + 564. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 37*s.* 6*d.* net.

In this volume the editors have brought together for the convenience of their fellow-chemists the first nine volumes of "Organic Syntheses", containing authentic methods for the preparation of 260 substances. In doing this they have not contented themselves with merely rearranging the matter previously published, but have made a large number of relatively minor yet significant corrections, and have incorporated new and improved directions for the preparation of adipic acid, benzilic acid, cyclohexylcarbinol, dibenzoylmethane, *d*-glutamic acid, glycine, *dl*-methylethylacetic acid, pentaerythritol, and *n*-propylbenzene. At the same time the illustrations of apparatus have been re-drawn and the quantities of corrosive liquids and all solvents have been given both in cubic centimetres and in grams.

Not the least of the many difficulties associated with the preparation of a book of this type is the indexing; but in the volume under review these difficulties have been overcome so successfully that the indexes are among its more commendable features. There is a "Type of Reaction Index", listing most of the preparations in accordance with some general type of reaction, such as acylation, halogenation, and oxidation; a "Type of Compound Index", in which preparations are listed, where possible, according to the group introduced; a formula index, an illustration index, and a general index, all of which have been made accessible by means of thumb index marks. The references to the literature, although not intended to include every published method for a given preparation, are plentiful and up to date.

It is a work which has been carefully and skilfully compiled, and can be unreservedly recommended to every chemist who is concerned with the preparation of organic compounds.

A History of Aircraft. By F. Alexander Magoun and Eric Hodgins. (Whittlesey House Publication.) Pp. xx + 495. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 21*s.* net.

This is an extremely readable American publication, which does not, as several others have recently, give undue prominence to American achievement. Its record ranges from Archytas in 400 B.C. to Post and Gatty in 1931, and concludes with a chapter entitled "The Present", which happens to be principally an attempt to look into the future.

The authors claim to have exercised Lytton Strachey's requisite for the historian, "ignorance, which simplifies and clarifies, which selects and omits . . .", and in the historical sections, using a restraint compatible with this humility, they have produced a remarkably concise and accurate précis of the world's aeronautical history, both mythological and actual. With contemporary history they are less happy, in that they have been led into reporting opinions, obviously biased by local outlooks, that they, as historians, should have avoided. For example, it will be news on the eastern side of the Atlantic that Sikorsky, in Russia in 1916, was the first person to produce a successful twin-motor aeroplane. Perhaps the literal accuracy of this statement turns upon one's interpretation of the word "successful". Also, that Hawker after his attempt upon the Atlantic flight in 1919 "vanished from the public stage", apparently because of his political indiscretions. The last chapter, with its attempts at forecasting the technical developments of the future, is a tactical error, and mars what otherwise is an interesting and logically written book. It is not in place in a history, neither do the authors appear to be technically able to deal with it.

The general lay-out is excellent, divisions being made according to classes of aircraft. This, combined with a chronology at the end of the book, makes reference particularly easy.

Gems and Gem Materials. By Prof. Edward Henry Kraus and Dr. Edward Fuller Holden. Second edition. Pp. ix + 260. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 18*s.* net.

The second edition of this useful work contains much new material, and is even more fully illustrated than the first. The work is divided, as before, into three parts—the first dealing briefly with the general properties of minerals, the second being concerned with descriptions of the individual gem species, and the third part containing tables of physical properties, etc., conveniently arranged for reference. A good index is provided.

The additional information concerning synthetic corundum and spinel embodied in the chapter on manufactured stones makes this one of the most valuable features of the book. A further improvement is to be found in the section on amber, which now provides an excellent account of the natural material and the properties by which it may be distinguished from its various imitations. The chapter on the cutting and polishing of gems has also been expanded. Less than two pages are allotted to the description of pearl, and the treatment is inadequate for so important a gem. The cultured pearl is briefly mentioned, but no account is given of the important modern methods used for distinguishing between natural and cultured pearls.

A mass of information is conveniently summarised in the concluding table (Table XI.). In this, wrong values are given for the specific gravity of benitoite, and the refractive indices of azurite and zircon—misprints which should be corrected in a future edition. The book is well produced and pleasant to handle, covering a wide field in a surprisingly small space. B. W. A.

The Microscopic Examination of Cattle Foods. By S. T. Parkinson and W. L. Fielding. Pp. viii + 97 (15 plates). (Ashford and London: Headley Bros., 1930.) 6*s.* 6*d.* net.

THE growing demand for detailed knowledge of the constituents of cattle foods has brought into prominence the need for adequate methods of analysis. Microscopic examination affords the only certain means of identification of the materials present, and hitherto a concise and systematic treatise dealing with the subject has been lacking. Parkinson and Fielding have now elaborated their own methods and have successfully attempted to set them out in such a way as to provide the student with a ready means of attacking a problem which bristles with difficulties.

The preliminary chapter is devoted to a description of methods, which are given in detail and would appear sufficient to meet most situations that are likely to arise. The main food plants are then dealt with in groups, including oil-containing plants, cereals, and leguminous plants, with a further chapter on such miscellaneous constituents as weed seeds, beet pulp, potato residues, and spent hops. Methods of identifying undesirable adulterants, such as sawdust, are also given to provide a test for purity. For each group, tables have been drawn up which enable comparisons between the different constituents to be made readily by selection and elimination. Additional information is provided by annotated photomicrographs of the chief features described and of the principal weed seeds. The volume meets a distinct need, and should prove most useful on the commercial side, as well as for training agricultural students in a better understanding of certain aspects of animal nutrition.

Cacao. By Dr. C. J. J. Van Hall. Second edition. Pp. xviii + 514. (London: Macmillan and Co., Ltd., 1932.) 28*s.* net.

DURING the last few years, increasing interest has been taken in problems relating to cacao cultivation and production. It is singularly appropriate, therefore, that a second and revised edition of what is generally regarded as the standard work on the subject should now make its appearance. In this new edition, the author, an acknowledged authority with wide experience of the crop, includes the results of all the outstanding work on cacao that has been carried out in various parts of the tropics since the appearance of the first edition in 1914.

The most notable addition to the work is the chapter devoted to breeding and selection. Here the author outlines the methods that are being adopted in such countries as Java, Trinidad, and Surinam to improve the yield and quality of the crop, and does not omit to point out the numerous difficulties that have to be faced. The information relating to pollination and fertilisation is of special botanical interest, as these phenomena in cacao have been so long shrouded in mystery, and it is only in recent years that light has been thrown upon them. The account of the improved technique in budding that has now been evolved should be of value to all those concerned in any way with propagation. In the chapter devoted to pests and diseases much that is new has been added, including accounts of the valuable work that has been carried out in this sphere in the West African cacao-producing countries.

The Phenomenology of Mind. By G. W. F. Hegel. Translation, with an Introduction and Notes by J. B. Baillie. (Library of Philosophy.) Second edition, revised and corrected throughout. Pp. 814. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1931.) 25*s.* net.

THE philosophy of Hegel is for the very large majority of people a closed book. Of all the philosophers, he is by far the most difficult to understand, and Sir James Baillie has performed a very great service in translating and editing a new edition of his "Phenomenology of Mind", which may be fairly looked upon as Hegel's *magnum opus*. The subject matter is, however, so abstruse that it is very difficult to understand, and a modern psychiatrist might be forgiven for regarding some of it as definitely dereistic thinking, a term which Bleuler has well defined as thinking away from reality.

The translator has very much lightened the reader's task by a well thought out and reasoned introduction of some fifty pages. We think it might well have been indicated, when discussing phrenology and physiognomy, that the ideas of Lombroso are not necessarily accepted by scientific criminologists of to-day. The value of the table of contents has been very much enhanced by the addition in brackets of remarks of the translator. These help to clarify the plan of the work, and help the reader on what cannot really be otherwise than a weary way.

Solutions superficielles, fluides à deux dimensions et stratifications monomoléculaires. Par André Marcelin. (Recueil des Conférences-Rapports de Documentation sur la Physique.) Pp. 163 + 4 planches. (Paris: Les Presses universitaires de France, 1932.) 80 francs.

M. MARCELIN'S book will be heartily welcomed by all those workers who are concerned with the chemistry and physics of surface phenomena. The author opens the book with a historical exposition, and, after a brief discussion of the physical state of surface solution, goes on to describe in full detail and very clearly the experimental methods in use to-day. He then, by means of a very full discussion of surface solutions of oleic and other acids, illustrates the properties of and regularities shown by such solutions.

Very interesting chapters follow, dealing with pseudo-solutions and their transformation into true surface solutions, and with the equilibrium between a solution and a surface solution. The influence on the Volta effect produced by the presence of a monomolecular layer is very carefully examined, and the book closes with an account of the properties of thin films. It is fully documented, is written with admirable clearness, and is a notable addition to a notable series. ALLAN FERGUSON.

Some Aspects of Applied Geophysics *

By Prof. A. O. RANKINE, O.B.E.

PERHAPS some apology, or at least explanation, is necessary for the choice of a subject for which I have not even been able to find a satisfactory title. Applied geophysics may clearly be taken to include certain aspects of meteorology or oceanography, or, indeed, any branch of knowledge in which physics is applied, in the service of mankind, to the elucidation of the properties of the earth. I propose to deal with what is in fact only a limited field of work. Put briefly, it covers the application of physical methods to the examination, without digging or boring, of what lies beneath the surface of the earth at relatively shallow depths of less than a few thousand feet. The application is more particularly directed to the discovery of deposits of economic importance, such as minerals or oil, or the structural formations with which they are likely to be associated.

Truly this is a subject as different as it could very well be from those flights of theoretical physics—relativity, quantum theory, wave mechanics, and the like—which those of us with slower minds and more pressing other occupations try so desperately to follow. In our admiration and, perhaps, envy of the apparent ease with which the pioneers in these new fields make progress, we are inclined, wrongly, I think, to allow it to be assumed that modern physics and atomic physics are one and the same thing. It should not be overlooked that physics is making rapid strides forward also in other directions. Much that is new in the precision of measurement, in the choice of methods, and in the invention and design of physical tools for the attack on old problems hitherto unsolved, has been added to our knowledge in recent years. This is true with regard to the particular branch of physics we are now to consider. Its fundamental basis is not new. It involves no appeal to, let us say, wave mechanics; the old gravitational theory of Newton and the electromagnetic theory of Maxwell serve well enough our purposes. Yet its successful application continues to demand the highest experimental skill that training in physics can provide, and initiative ability equal to that more frequently directed in less practical channels.

The subject is also a border-line one, and, perhaps for that reason, has not received so much attention as it deserves, at any rate in Great Britain. Its practice involves the co-operation of geologists with physicists, except in those rare examples of the same person being expert in both branches of knowledge. It was a famous geologist, the late Prof. de Böckh, who suggested to the equally famous physicist, Baron von Eötvös (whose work we shall consider more fully later), that the Eötvös torsion balance should be used to locate and delineate buried salt domes—geological features with which oil is frequently associated. Prof. de Böckh once told me that at first Eötvös was horrified at the idea. He regarded the use of his instrument for such an economic purpose as debasing science, and it was only with great difficulty that he was eventually persuaded to initiate what has now become a common and successful practice in various parts of the world.

I may perhaps mention, too, that when I first became interested, about five years ago, in applied geophysics, I was very doubtful of its use. Could conditions underground, I asked myself, ever be so simple and free from complications that physical observations on the surface would point unequivocally to the solution? The answer to this question is, generally speaking, in the negative; but here the geologist comes in again. He carries out his preliminary survey by his own methods, and is often able to indicate both the limited region where a geophysical survey seems desirable and, in a general way, the kind of formation which is to be sought, thus enabling a suitable choice of method to be made. He provides, in fact, the *selection rules* for the geophysicist, in much the same way as the quantum theorist does for the spectroscopist, as regards both where to look and what to expect to find. It is true that sometimes a *forbidden* result persists in obtruding itself inconveniently upon the geological interpretation, just as a *forbidden* spectral line may refuse to be extinguished. But usually the solution of a problem has to depend upon the combined result of geological and physical evidence, and is only approximate at that.

It is mainly the physical basis of the work that I wish to review. Here I should point out that this limitation will exclude 'divining', whether for water or any other underground feature. Innumerable claims of successful use have been made for the divining rod and similar indicators, but the *modus operandi* has never been explained, and none has been established on an acceptable physical basis. But I am glad to escape from this highly controversial ground by defining in a sufficiently exclusive manner what is a geophysical method in relation to the search for minerals. The basis of every geophysical method is the differentiation, usually abrupt, of some physical property as between rocks. The four principal methods—gravitational, magnetic, seismic, and electrical—depend, in fact, upon differences, in the various media underlying the earth's surface, of density, of magnetic susceptibility, of velocity of elastic wave propagation, and of electrical conductivity respectively. Associated with these variations of physical properties, either naturally or through stimulation by artificial means, there are produced, at or near the earth's surface, calculable physical effects which may be capable of measurement by suitable apparatus. There must be something physical to measure, and the instrument must be able to measure it.

* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at York on Sept. 2.

The Gravitational Method

I do not think that Eötvös has yet received in Great Britain the full recognition which his work deserves. Possibly this is because the early accounts appeared in rather inaccessible journals; or, possibly, there were real doubts concerning the validity of his claims. I remember, as a student, hearing vaguely about his experiments—and his name, without anyone knowing how to pronounce it. In the same lectures we learnt much fuller details of Boys's classic measurement of the constant of gravitation, without realising how remarkably similar in essential form the Eötvös and Boys instruments were. But the fact is that when Boys was inventing and making the quartz fibres for his torsion balance to weigh the earth, Eötvös had already tackled successfully the difficult task of making robust and portable for field work another torsion balance of not greatly inferior sensitivity. While Boys was busy with his measurements in a constant temperature cellar, Eötvös was completing the protection of his portable instrument against the temperature variations inevitable in the rigours of the field. A few years later he made notably successful gravitational surveys on the frozen surface of Lake Balaton and on the Great Hungarian Plain; but it was not until Shaw and Lancaster-Jones had demonstrated in 1923 that an Eötvös balance, acquired for the Science Museum before the War, behaved according to specification, that the remarkable nature of Eötvös' achievement began to be appreciated here.

Even now I do not think it is well enough understood how small were the effects which Eötvös measured under the unfavourable conditions of field work. We can illustrate this in a very striking way. The earth's gravitation field, even apart from local irregularities, is not uniform, or, rather, spherically symmetrical. Owing mainly to the earth's rotation, the apparent value of the gravitational intensity increases in passing from equator to pole. The total change is about 5 cm./sec.^{2}, and the maximum rate of horizontal variation is at latitude 45°. In this region the change of g for a step of one metre northwards is 8×10^{-7} cm./sec.^{2}, or, approximately, only one thousand millionth of the gravitational acceleration. This the Eötvös torsion balance was capable of indicating definitely, being several times as large as the limit to which the instrument would respond. Further, the measurement could be made with the instrument occupying a single position in a space of less than a square metre, simply by making observations with the apparatus as a whole in a number of different azimuths. Eötvös, in effect, multiplied by a thousand the accuracy of measurement of terrestrial gravity variations.

This remarkable sensitivity was secured by deliberately excluding gravity itself from exercising any control in the instrument, which was constructed so as to respond only to *variations* of the gravitational field.

It would take too long to describe the instrument, and at the same time do justice to those used in other branches of geophysical surveying. It must suffice here to indicate that the Eötvös torsion balance provides means of measuring, normally by observations of the changes of torsion accompanying changes of azimuth of the instrument as a whole, two properties of the local gravitational field, each having magnitude and direction. The magnitude of the first, for which a satisfactory name has not yet been devised—the *horizontale Richtkraft* according to Eötvös—is the product $g(c_1 - c_2)$, where c_1 and c_2 are the greatest and least curvatures of the local 'level' or equipotential gravitational surface; its direction is horizontal and in the vertical plane of least downward curvature. The other departure from gravitational uniformity which the balance measures is the *gravity gradient*, or the rate of change of the vertical gravitational intensity with horizontal distance in the direction in which the change is greatest. It is a vector, and both its magnitude and direction can be obtained from the instrumental observations.

The reaction of the instrument to these two differential 'fields' provides the means of measuring the particular gravitational distortions which they represent. This part of the work is pure physical measurement of a straightforward character, and attaining, as I have indicated, a surprising degree of precision. It is in the interpretation of the results that the real difficulties arise. The problem is to ascertain to what extent the gravitational irregularities measured are due to density differences in the buried structure, and to assign to the latter a position and shape consistent with the observations. In country where the surface is otherwise than virtually horizontal it is necessary to survey its irregularities and make calculated allowances for their contribution to the total measured gravitational distortion. This topographical effect may indeed sometimes be so large in comparison with that of hidden structure as to render gravitational surveying ineffective. The earth's rotational effect, of course, has always to be eliminated, but this presents no difficulty. What remains after these corrections constitutes the data for geophysical interpretation; and this is the stage where the geologist's 'selection rules' have to be applied. As in all geophysical methods, interpretation is necessarily indirect. Underground structures, agreeable to the geologist's experience, have to be taken as hypotheses, and tested by calculation and comparison with the data provided by surface observations.

I have, rather regretfully, to leave at this stage this part of my subject. My recent practical experience with torsion balances has aroused in me the greatest admiration for the work of the original inventor and his successors, and for the skill and precision with which most of these remarkable instruments have been constructed by the makers. It comes as something of a shock, even though we do not doubt the universal law of gravitation, to see for the first time a small mass of gold being attracted by a neighbouring lead sphere a few inches in diameter. With a torsion balance at our disposal the same becomes commonplace, and is indicative of the great power of these instruments

for geophysical purposes. Accumulated evidence from the field confirms this view. There is convincing proof that extensive underground features, such as salt domes, limestone anticlines and synclines, rock faults, and deposits of hæmatite or of brown coal, produce, if not too deeply buried or masked by complicating irregularities, gravitational disturbances large enough to lead to their delineation.

The Seismic Method

The seismic method of prospecting began to be used about 1919, chiefly owing to the initiative of Mintrop. To some degree it has replaced the gravitational method, on account of the greater speed with which it enables a given area to be surveyed—a most important economic criterion, of course. But there are other important reasons why, under certain conditions, it must be preferred. If, for example, the topography of the country is too irregular for the corresponding corrections to be applied reliably to torsion balance observations, gravity surveying is excluded ; and seismic work, which is not so sensitive to surface conditions, may still prove of value. Again, the structure to be determined may itself settle the choice of method. For example, if the problem were to determine the depth of a horizontal interface of discontinuity between two strata of very great extent, the torsion balance would not find anything to measure ; the seismic method, on the contrary, would be confronted, as we shall see, with its most direct and simplest task. But while admitting these undoubted advantages, and recognising the many notable successes of seismic surveying under suitable conditions, it is necessary to state that this method does not yet rest on so sure a theoretical foundation as the law of gravitation ; nor do the portable seismographs employed give records so unambiguous as the readings of the torsion balance.

The basis of the seismic method is the same as that underlying the investigations of the propagation of earthquake shocks in relation to the determination of the structure of the earth's crust. The difference is only one of degree. In so far as there is a theory of natural earthquake propagation, it serves also for the seismic method of geophysical prospecting. In trying to determine the depth of an underground stratum, the most direct method of attack would be to measure, if possible, the time of travel of a particular disturbance from the surface to the interface and back to the surface after reflection. This method has been used with great success in determining the depth of the ocean by means of the Admiralty echo-sounding machine. But it fails in application to the solid earth, for the reason that the attenuation of vibrations with distance is far greater in the earth than in the sea ; consequently, much larger initial disturbances have to be used—in fact, violent explosions. Even if—as ought always to be done for the sake of efficiency—the explosion is arranged so that the surface of the ground is not broken, thus eliminating danger to observers, the delicate seismographs cannot as yet be properly protected against the direct effect. They would thus be so greatly disturbed as to mask completely the onset of the small reflected disturbance arriving shortly after. This effect, indeed, persists to a less but still important degree even when the seismograph is removed to quite large distances from the explosion. It is true that some important results have been obtained by employing this so-called reflection method, but the reading of the records is a matter of considerable uncertainty, owing to the difficulty of identifying the time of onset of the reflected disturbance in the midst of the effect of that propagated directly.

This uncertainty has led to the more general adoption of a method, properly called the diffraction method, although the term 'refraction' is sometimes incorrectly used. Its great advantage is that it enables the inevitably feeble disturbances, which have penetrated to and through the lower medium, to reach the seismograph, under certain conditions, *in advance* of the much greater direct wave. Consequently, the times of arrival of these indirect, or diffracted, disturbances are recorded unmistakably upon the seismogram, however much the instrument may be agitated later on.*

The principles of the method can be readily applied to structures less simple than a single horizontal interface ; and the observations obtained in the field, plotted on time-distance graphs, enable such features as the slopes and curvatures of strata and the depths of more than one successive bed to be recognised under favourable conditions. For success the principal requirement is a large velocity-ratio as between the rocks constituting the various beds. Salt domes under alluvial deposits, for example, are in this respect suitable structures, and the location of many such domes was the first achievement of the seismic method. It has also been employed with valuable results in determining the underground contours of limestone anticlines and deep-seated granitic basements at depths of several thousand feet.

The Magnetic Method

We pass now to the magnetic method. In actual practice it is the simplest and least costly. It consists of measuring, with suitable portable magnetometers, local variations of components of the earth's magnetic field, usually the vertical and horizontal intensities. The instruments which have been designed for the purpose enable observations to be made quickly, so that a large number of stations can be occupied and a wide area covered in the course of a single day. Under suitable conditions, therefore, much information regarding underground structure may be obtained by means of a survey lasting only a relatively short time and involving comparatively little expense. But it should be pointed out that this apparent economy has sometimes led to the method being employed on problems for which it is at present unsuitable, and to claims being made as to its performance which are doubtful.

It is necessary to bear in mind that the basis of magnetic surveying is the differentiation of rocks in

* The theory and practice of the seismic method is discussed in articles in NATURE, **123**, 684, 718, May 4 and 11, 1929.

respect of magnetic susceptibility, and the consequent discontinuities of magnetisation under the influence of the earth's general magnetic field. For the field distortion thereby produced at the earth's surface to be marked, it is necessary for the responsible rock structure to have a large susceptibility; this implies that only highly ferruginous rocks will be easy to find.

I do not mean to imply that the magnetic method of surveying is limited to the detection of ore bodies like magnetite. Igneous rocks generally, and particularly basalt, may contain considerable quantities of iron, and consequently possess an effective magnetic susceptibility much larger than non-ferrous materials. There is abundant evidence that structures of such rocks have been determined, under favourable conditions, by the use of magnetic variometers. But if we are to hope to bring within the scope of the magnetic method non-ferruginous underground formations, we must improve greatly the sensitivity of the instruments, and at the same time exclude the operation of certain disturbing factors.

The chief difficulty with the variometers at present available is the application of the corrections for diurnal variation of the earth's field and for temperature changes. If we could escape the necessity of applying the corrections which these important effects involve, we should feel much safer in attaching significance to anomalies only a few times larger than the limit of measurement of the apparatus.

A year ago I thought I saw the way to do this, and brought a method before this Section of the British Association. It was to make use of the essential principle which gives to the Eötvös gravity balance its extraordinary sensitivity, namely, to measure the space-variation only of the forces in question. I found later that Eötvös himself had worked on these lines, and actually constructed an instrument partially fulfilling the conditions; although it is not clear that he realised the full significance of complete success. I have to confess that unexpected practical difficulties of construction have so far prevented realisation, but I have not given up hope that a magnetic instrument can be constructed to operate in the same way as the proved gravity instrument. Accordingly, it may be worth while to indicate what a device of this kind might be expected to achieve.

The chief virtue of such a magnetic torsion balance is that it would discriminate between *time-variation* and *space-variation* of the earth's magnetic field. The variation with time of a magnetic field remaining spatially uniform would not affect it; it would respond only to a sufficient distortion in space. Calculation shows that with the magnets and suspending wires now available we could anticipate an instrument which would be just about sensitive enough to respond, in the average magnetic latitude, to the non-uniformity of the earth's main field. The additional lack of uniformity arising from diurnal variations, or even magnetic storms, is by comparison small, because the amplitude of the variations is only a small fraction of the total field, and they are very widespread in character; consequently, they would fail to disturb the instrument appreciably. We should therefore be able to attribute the distortion observed solely to local magnetic features, apart from a nearly negligible correction for general earth's magnetism. The effect of changes of temperature also would be comparatively small, for they would be proportional to the variation of field intensity over the limited space occupied by the suspended system, instead of to the full intensity at the station. In the gravity torsion balance they are, in fact, negligible, and they could be made equally so here.

Electrical Methods

I have left until last reference to electrical methods, not because they are of less importance, but because I am less familiar with them, and could not speak with any of the authority which comes from practical experience. Accordingly, I shall simply use this opportunity of directing special attention to the work of the Imperial Geophysical Experimental Survey ("The Principles and Practice of Geophysical Prospecting": Cambridge University Press, 1931), which operated in Australia from 1928 until 1930. This survey, under the leadership of Mr. Broughton Edge, whose extensive experience of electrical surveying is well known, was concerned chiefly with electrical investigations. It is, I think, no exaggeration to say that the report is the most comprehensive and authoritative treatment available of the subject of electrical surveying.

Future of Geophysical Surveying

Much, however, remains to be done in all branches of geophysical surveying, in order to put it on a more secure basis and to determine more certainly the scope of its applications. It must be confessed that until quite recently practically all the work was being done by German investigators. By its nature the work is necessarily costly. Except as regards some aspects of the construction and improvement of instruments, it cannot be confined to a laboratory; and, with the same limitation, it can rarely be an individual effort. Effective research in the field implies adequate scientific personnel, transport, labour, and materials, in addition to the instrumental equipment. If we are to make substantial progress in this direction, the expense must be faced.

I recognise that it would be foolish, as well as useless, to press now for the initiation of any costly schemes. But it is permissible to hope and believe that the subject will not be completely neglected in these difficult times. We can occupy the lean years in making ourselves more familiar with what is already known, and in conducting new investigations on a modest scale—as, indeed, is being done at South Kensington by the Imperial College with the assistance of the Department of Scientific and Industrial Research. Then, when the fat years come, and the mining industries again call for the help of geophysicists, we shall be found, at least, not wholly unprepared.

The Adequacy of Human Dietaries

HOW far the food ordinarily consumed by different individuals provides an adequate amount of the different dietary essentials, and to what extent an improvement in the diet might lead to a general improvement in health and wellbeing and a decrease in the incidence of disease, are important questions. The answers depend in the first place upon a knowledge of all the factors which go to make up a complete diet and of the quantity and quality of the food actually consumed. The essentials of a diet are now well established, but our knowledge of the adequacy of common diets is still very incomplete. The investigations of Cathcart and Murray on the diets of a number of families in St. Andrews have already been described (NATURE, 127, 897, June 13, 1931): the same authors have now published the results of an investigation into the diets of 56 families in Cardiff and 57 families in Reading.*

In this survey a horizontal instead of a vertical section of the community was selected for investigation, since for all practical purposes further examination of the diets of those comparatively well off appeared to be unnecessary. The numbers involved in the study were 378 at Reading and 370 at Cardiff.

It was found that the 'man' value per family was 4·55 at Cardiff and 4·35 at Reading, the 'diet man' values being respectively 4·54 and 4·30. The calorie consumption per 'man' per day was at Cardiff 3174, obtained from 79 gm. protein, 114 gm. fat, and 441 gm. carbohydrate: the corresponding figures for the Reading families were 2906 cal., 75 gm. protein, 101 gm. fat, and 408 gm. carbohydrate. The distribution of the calories between the proximate principles was, in each case, about 10 per cent from protein, 32-33 per cent from fat, and 57 per cent from carbohydrate, a very similar distribution to that found at St. Andrews. The Cardiff families spent more money on both food and rent than the Reading families. Comparison with other studies indicates that these values are more nearly comparable with those of the Glasgow artisan class than with other groups in Glasgow or Dundee. The fat consumption of the English working classes appears to be much greater than that of the Scottish. The amount of the income spent on food is 70-90 per cent in Glasgow, 45 per cent in Dundee, and 57 per cent in Cardiff and Reading.

At Cardiff the families with the largest incomes consumed most protein: at Reading this was not the case. The Cardiff families also derived a slightly greater proportion of their protein from animal sources. In the case of the unemployed families, the Reading diets were found to be of lower caloric value than the Cardiff, but contained a higher proportion of fat. 8 Cardiff and 12 Reading families consumed 2500 cal. a man or less. This was found to be due chiefly to the improvidence of one or both parents: at the same time it was noted that the English families spend much more of their weekly income on rent than the Scottish.

At least 73 per cent of the mothers in the Cardiff families could be classed as good, and 93 per cent in the Reading families. It is of interest to note that in Cardiff the 'bad' mothers spent most on food (70 per cent of the total income), whilst in Reading it was the 'good' mothers who utilised the greatest proportion of the family income on the purchase of food (58 per cent).

Little or no evidence of any real under-nutrition, as compared with the rest of the community, in the children of the relatively poor families was obtained.

In this study, only the quantitative aspects of the diets were considered, and no attempt was made to determine their adequacy in minerals or vitamins. The Advisory Committee on Nutrition to the Ministry of Health has recently examined and criticised diets in common use taking these aspects into consideration.† A simple method of calculating the calorie, protein, fat, and carbohydrate content is described. It is pointed out that at least 80 gm. protein and 50 gm. fat should be consumed daily and that the percentage of calories derived from carbohydrate should not be much greater than 66. About 37 gm. protein or 5 per cent of the total calories should be animal protein, of high biological value: this can be obtained from cheese, eggs, fish, milk, and meat. Minerals and vitamins are provided by milk and milk products, fresh salad vegetables and fruits, liver, fish, especially fat fish and fish roes, and eggs: their intake should be adequate if each individual consumes 1 pint of milk daily, partakes freely of cheese, if one orange or tomato or helping of raw salad is taken daily, if 1 oz. a day of butter (or vitamin margarine) is given and if a fat fish such as herring appears in the winter menu once a week (or half a teaspoonful of cod liver oil is taken once a day).

A diet is not usually deficient in calories, but may be so in first class (animal) protein and in the protective foods which supply the minerals and vitamins: it is then a simple matter to improve it by supplying these dietary essentials. Scrutiny of the diets in the children's homes visited showed that cheese was rarely given, that salads were not supplied in winter, and that ordinary (and not vitamin) margarine was generally used. It is recommended that the diets be improved by giving 1 pint of milk a head each day, by including green vegetables and carrots in the dietary, as well as apples or oranges, by using vitamin margarine, and supplying cheese, ox liver, fish roes, herrings, tomatoes, and watercress. An important point is that the menus should be varied so that certain dishes are not served on one particular day of the week for weeks on end: in this recommendation the importance of stimulating the appetite is recognised as a factor to be considered in any dietary.

* Medical Research Council. Special Report Series, No. 165: Studies in Nutrition—An Inquiry into the Diet of Families in Cardiff and Reading. By E. P. Cathcart and A. M. T. Murray, assisted by M. Shanks. Pp. 28. (London: H.M. Stationery Office, 1932.) 6*d*. net.

† (1) Memorandum to the Minister of Health on the Criticism and Improvement of Diets. (2) Report to the Minister of Health on Diets in Poor Law Children's Homes. Ministry of Health: Advisory Committee on Nutrition. (London: H.M. Stationery Office, 1932.) 3*d*. net each.

Obituary

PROF. FRAN JESENKO

YUGOSLAV science, and the University of Ljubljana in particular, has suffered an irreparable loss by the untimely death, on July 16, of Prof. Fran Jesenko, professor of botany at the University of Ljubljana, in consequence of an accident in the Julian Alps.

Jesenko was born near Ljubljana in 1875. He was educated there and in Vienna, where he graduated in 1902. In 1901 he was appointed tutor to two Oriental princes at the Teresianum, the well-known college for boys in Vienna. A similar appointment in the family of Count A. Merveldt, with whom he travelled to Egypt, gave him a good opportunity to study the desert flora. He was afterwards commissioned by the Vienna Botanical Institute to study the flora of Petræa, and at that time he also visited Persia, whilst he was the first Slovene to travel through the Sahara. Upon his return from his travels he studied in Uppsala and Paris. It was during his stay in Sweden that he became an expert in ski-running, and throughout his life he always found time to cultivate that sport.

On his return to Vienna, Jesenko was appointed assistant to Prof. Czermak at the Vienna School of Agriculture, and in 1913 lecturer at the Vienna Botanical Institute. It was during this period that he began to devote himself to what may be described as his life work, namely, the evolving of a fertile cross between wheat and rye. At the fourth International Conference on Genetics, held in Paris in 1911, he was able to report the progress of his experiments in a paper, "Sur un hybride fertile entre *Triticum stativum* et *Seccale cereale*", whilst at the time of his death his research had advanced so far that the next step would have been the cultivation of the new cereal on a fairly large scale at an experimental farm.

Jesenko was corresponding member of scientific societies in Great Britain, America, Tokyo, Leningrad, Uppsala, and Paris. We may quote a few of his early works as follows: "Beziehungen zwischen der Lichtintensität und dem anatomischen Bau der assimilierenden Organe von Wüstenpflanzen" (1907); "Einige neue Verfahren die Ruheperiode der Holzgewächse abzukürzen" (1911–12); "Über das Austreiben im Sommer entblatterten Baume und Straucher" (1912); "Versuche über die Turgenszensdauer abgeschittener Pflanzensprosse" (1910); and "Über Getreide-spezies-Bastarde (Weizen-Roggen)" (1913).

In 1914 he was called up for active service, and during the War suffered seven months' internment in Bohemia, because of his sympathies with the Slav cause and the Allies. After the War, his opportunity came with the constitution of the new Yugoslav State. In 1919, Jesenko was first appointed lecturer, and then professor of botany at the University of Zagreb, and in the following year was transferred to the newly founded University at Ljubljana. Here he had all the hard work, but also the satisfaction, which attends pioneer work. He soon conceived the plan of marking off part of the famous Triglav Lakes Valley as a national park, a plan which, in spite of great difficulties, he succeeded in realising.

On July 12, Jesenko set off to join his students at their headquarters in the Triglav Lakes Valley. It is assumed that whilst stepping aside from the steep path up the Komarcha Crag to look at some plant, his heavy pack caused him to overbalance on the precipitous and treacherous slope. He was found by some tourists a little later, his spine broken. He was removed to Ljubljana Hospital, where he died on July 16.

Jesenko was an able linguist and spoke fifteen languages. He possessed a beautiful singing voice; at one time indeed it seemed doubtful whether he might not choose the career of a public singer. His death will be widely deplored, but most of all by his students, whom he imbued with his own enthusiasm and devotion to his work, whilst all who had experience of his kindness and generosity will regret the premature death of the man no less than that of the naturalist.

MR. HERBERT KNAPMAN

IN Herbert Knapman, registrar of the University of Reading, who died on Aug. 14 at the age of fifty-two years, the lover of music and philosophy and the tireless organiser had long survived the brilliant mathematician who went to Cambridge from Rugby in 1898, was second wrangler in 1901, Smith's prizeman in 1903, and a fellow of Emmanuel College from 1903 until 1909. He joined the staff of University College, Reading, in 1903 as a lecturer in mathematics. If as a teacher he inspired awe of himself rather than love of his subject, the intense thoroughness which was his second nature brought a measure of success, and for a time he was even interested in the technique of imparting knowledge. Nevertheless, the steady transfer of his energies to the field of administration was a congenial development, and although the co-ordination of innumerable details seemed to his colleagues sometimes to be a waste of his intellect, there is no reason for supposing that the services which he performed, especially just after the War and at the time of the foundation of the University, so much better than a man less able could have hoped to do, withheld him from any more valuable work that he might have accomplished. The only work which he did as a mathematician was on the Subject Index of Pure Mathematics for the Royal Society Catalogue of Scientific Papers.

Knapman's lifelong passion was for music, of which he had a wide and expert knowledge. His one published paper described some experiments in which he observed a series of harmonic undertones excited by a tuning-fork; the observations were forgotten until the effect was rediscovered twenty years later, and it is evidence of the extraordinary delicacy of Knapman's ear that while he recorded

that ten of the undertones could be heard easily, Dr. Bond, with the same fork, could distinguish the fifth only occasionally.

In spite of lameness, Knapman was for the greater part of his life a strenuous pedestrian; latterly exertion told visibly on him, and he could not easily resign himself to physical inactivity. When eye-strain, though temporary, threatened further to limit his powers, he became acutely depressed, and the end followed rapidly.

An abrupt manner belied fanatical devotion to the University, and impatience with stupidity was balanced by a ready approval of good work. His judgment of men and affairs was valued not only by his colleagues at Reading, but also throughout the wide circle of educational administration in which he was a well-known personality. The perfection of his routine remains, permanently to strengthen the office with which he was associated, but the wit that lit up suddenly the stormiest or gloomiest of committee meetings and played like summer lightning on the rare evenings when he gave himself up to social enjoyment is lost, except in the memory of those who knew him. E. H. N.

DR. J. STUART THOMSON

THE many friends and old pupils of Stuart Thomson will sincerely regret to hear of his death, at the age of sixty-four years, which occurred suddenly after a short sea trip, at Swansea, on Aug. 28. For many years Stuart Thomson, who was the brother of Sir J. Arthur Thomson, was senior lecturer and demonstrator in zoology in the University of Manchester, and many generations of medical and science students in Manchester had the advantage of his patient and sympathetic teaching. His wide knowledge of his subject—and particularly of vertebrate zoology—gave him authority in his lectures, which impressed those who heard him.

Stuart Thomson studied at Edinburgh and Freiburg, and also under Prof. Studer in Berne, who gave him an interest in the group of Alcyonaria on which in later years he became a recognised authority. He held teaching appointments in biology at Edinburgh and Plymouth, and in 1903 became assistant Government biologist at the Cape of Good Hope. In 1910 he returned, going first to Bristol and then to Manchester.

Stuart Thomson was the author of many valuable papers on the Alcyonaria of South African waters, all of them characterised by his patient investigation and careful description of detail. The last of these papers, published in the *Transactions of the Royal Society of South Africa*, in which the problems concerning the geographical distribution of the South African Alcyonaria are fully discussed, is of great general interest and a very remarkable piece of work.

In his later years Stuart Thomson devoted his spare time to the preparation of an elaborate memoir on the anatomy of the tortoise, of which no complete account has been published since the time of Bojanus.

Stuart Thomson resigned his post in Manchester in 1926, on account of failing health, and went to live with his sister in Cirencester, where he spent much of his time in preparing his book for publication. A few weeks ago he expressed the desire to go once more to sea, and his wish was fulfilled in a five days' cruise, but he died suddenly on landing at Swansea. S. J. H.

WE regret to announce the following deaths:

Dr. J. A. Clubb, formerly curator of the City Museum at Liverpool.

Prof. W. H. Sherzer, head of the Department of Natural Science at the Michigan State Normal College, known for his work in geological survey in Michigan, on July 17, aged seventy-two years.

Mr. S. Williamson Wallace, formerly director of the Egyptian Government College of Agriculture and director of agriculture for the State of Victoria, on Sept. 10, aged seventy-seven years.

Dr. A. Wilmore, formerly lecturer in geography at the Westminster Training College and principal of the Technical School, Colne, author of several well-known textbooks of geography and geology, on Sept. 6, aged seventy years.

News and Views

Forestry and National Economy

SIR JOHN STIRLING MAXWELL, formerly chairman of the Forestry Commission, has an article on "Forestry and National Economy" in the *Empire Forestry Journal* (vol. 2, No. 1, 1932). He confines himself to the work of the Forestry Commission in Great Britain and deplores the economy and cuts, which he admits were inevitable under existing conditions. Sir John himself gives the obvious reason why the heavy non-productive expenditure of the Commission could not hope to escape curtailment in the words: "It is unlikely that absolute continuity in the scale of forestry operations will ever be secured except where the expenditure in the forests is wholly met from the revenue they produce. It will be 30-40 years before this happy state of things can be reached in Great Britain." But he points out that the Forestry Commission can seize the opportunity offered and consolidate the work already accomplished and overhaul methods of organisation. In the dominions, the period at which the forests will pay their way may be reached earlier. In India it has been reached already. In the Crown Colonies, where the form of government is more autocratic, continuity ought to be easy of achievement when once the authorities realise the fatal folly of economising on productive expenditure. This latter point has already been alluded to in NATURE (June 11, p. 845).

IN discussing the present position of the Forestry Commission, Sir John gives a brief summary of the work of the first ten years. £9,000,000 was eventually sanctioned for the work to be carried out during the

following ten years. As a result of the May Report on Economy, the annual sum made available to the Commission was cut down by 50 per cent for the next five years. This cut has been met in two ways: first by reducing the provision of forest workers' holdings to the number absolutely necessary for the working of the forests, and, secondly, by stereotyping the annual planting programme at 20,000 acres or thereby, which will substantially reduce expenditure on acquisition of land. An expanding programme necessitates land acquisition on a large scale. Under a stabilised programme, acquisition can be limited to the replacement of the area actually planted. The reduction in area annually required works out at about 40,000 acres. These changes mean that the machine will take longer to arrive at its goal, but that it will not be thrown out of gear. No labour is to be paid off, and elasticity has been achieved partly by the distribution of the planting work all over the country and partly by the fact that the programme has been an expanding one.

National Research Laboratories, Canada

ON Aug. 10, the new National Research Laboratories of the National Research Council of Canada were officially opened in Ottawa by the Governor-General, the Earl of Bessborough. Among other speakers at the official opening were the Prime Minister of Canada, the Right Hon. R. B. Bennett, and Dr. H. M. Tory, the president of the National Research Council and the National Research Laboratories. A description of the building and the proposed organisation of departments and staff was given in NATURE of Jan. 4, 1930. The building is severely classic in style and closely follows the design of the architect's model reproduced in our article. It comprises four stories and basement, and encloses two large interior courtyards, which give ample light to all laboratory rooms overlooking them. Under each courtyard is an arched exhibition hall. There are three main divisions of research, namely, physics and engineering, biology and agriculture, and chemistry. There is also a division of research information which will be responsible for the publication of the *Canadian Journal of Research*, annual reports, technical reports, and bulletins. In the south-west wing is a series of industrial exhibits. Many delegates to the Imperial Economic Conference were present at the opening ceremony, and the Right Hon. Stanley Baldwin presented a number of portraits of eminent men of science which were given by Surgeon-Capt. Hanson.

National Research Council of Canada

THE Report of the National Research Council of Canada for the year 1930–31 states that although industry has been under a cloud, during the year the demand for scientific assistance addressed to the Council has increased greatly. There are now 29 research committees associated with the Council in the solution of scientific and technical problems which arise in industry, and the annual expenditure is a little more than 550,000 dollars. Five fellowships of 1200 dollars, 22 studentships of 1000, and 35 bursaries of 800 dollars a year have been awarded, and 35 researches conducted in Canadian universities have been assisted during the year. From the summaries of the activities of the associated committees and of the reports on assisted researches, it is evident that Canada is building up a corps of research workers whose influence on the future of her industries is likely to be most important.

New Mount Everest Expedition

A NEW attempt to reach the summit of Mount Everest will be made in 1933. The announcement of the expedition, which appeared in the *Times* of Sept. 3, is made by Admiral Sir William Goodenough and Brigadier-General C. G. Bruce on behalf of the Royal Geographical Society and the Alpine Club respectively. The last expedition was in 1924, when Mr. G. L. Mallory and Mr. A. C. Irvine lost their lives within some two hundred feet of the summit, if they did not actually reach the top. On the same expedition, Col. E. F. Norton and Dr. T. H. Somervell climbed to 28,200 feet. The previous attempts were in 1922, when a height of 27,300 feet was reached, and in 1921, when the expedition was a reconnaissance of the routes. Since 1924 the difficulty in renewing the work has been due to the unwillingness of Tibet to grant permission. Now, however, the Dalai Lama has given consent to a British expedition and arrangements are in active progress. The leader of the expedition will be Mr. H. Ruttledge, late of the Indian Civil Service, who has had considerable experience of mountain climbing in the Himalayas. The office of the expedition will be at the house of the Royal Geographical Society, South Kensington, S.W.7, and the secretary is Mr. J. M. Scott, who was a member of the British Air Route Expedition to Greenland.

New Archæological Periodical

THE new archæological publication *Préhistoire*, of which the first number has just been issued, has been planned on lines differing from those of any archæological periodical now running. Its contents will consist entirely of original memoirs, and it will include neither reviews of books nor current news; while in scope it will cover the archæology and art of the pre- and protohistoric periods, that is to say, from the earliest times up to the foundation of the great empires of antiquity. The articles will be descriptive—these dealing with the latest discoveries—statements of new theory, or syntheses taking a broad survey of facts. A special feature will be the illustrations, which in the case of each communication will be adequate to the requirements of the subject, and, in any event, more ample than could be given in the general run of archæological periodicals. It is hoped that the ampler space and fuller illustration which will be available, will make it possible to include in *Préhistoire* studies of which the publication has been impossible up to now owing to their requirements in these respects. The new journal is edited by M. Raymond Lantier with an international editorial committee, which includes, among others, Comte Bégouen, the Abbé Breuil, Mr. Miles Burkitt, Prof. Bosch Gimpera, Prof. H. Obermaier, and Dr. O. Menghin. The first issue contains contributions by

Dr. Henri Martin on the Solutrian sculpture of Roc, Prof. H. Obermaier on the late Magdalenian art of the Grotte du 'Pendo', near Santander, and a long and very fully illustrated study by Dr. R. Forrer of the prehistoric ritual chariot and its survivals in historic times (see NATURE of Sept. 10, p. 404). Not only are the illustrations of each article ample, but they are also of a high quality. The price of Part 1 is 125 fr., but owing to the fact that the size of the parts will be variable, the price is not fixed. The annual subscription, however, is 250 fr. The publishers are Librairie Ernest Leroux, Paris.

Prof. J. W. Gregory

FOLLOWING the obituary notice of Prof. J. W. Gregory by Sir John S. Flett (NATURE, June 25, p. 930) and the letter of appreciation by Prof. Bailey Willis (NATURE, Aug. 27, p. 310) we have just received a copy of an appreciation by Mr. F. Chapman, palæontologist to the Commonwealth of Australia, who was a lifelong friend of Prof. Gregory, published in the *Melbourne Age* for July 16. Much of Mr. Chapman's testimony is naturally concerned with Prof. Gregory's activities during the short period (1900–4) when he was professor of geology and mineralogy in the University of Melbourne. Victoria offered many fascinating geological problems ready to hand, and Prof. Gregory took advantage of these for a thorough training of his students in field work. One of his expeditions with a party of students to Central Australia resulted in his writing one of the finest geological essays, "The Dead Heart of Australia".

Prehistoric Persia

SHOULD subsequent investigation confirm the tentative attribution of a date contemporary with Susa I. to the Stratum I. in the mound now under excavation by the American Institute of Persian Art and Archæology at Damghan in northern Persia, the discovery fully justifies the claim for interest and importance made by Dr. Arthur Upham Pope in his letter to the *Times* of Sept. 12. He states that Dr. Erich Schmidt, field director of the expedition, has found in that stratum beautiful hand-made pottery and copper implements upon which he bases his suggested dating. He regards the lowest levels of the mound upon which the expedition is now engaged as coming very close to the fourth millennium B.C. Further evidence of this extension of the early painted pottery culture will be awaited eagerly. The important structure revealed in Stratum III., dating from about 2000 B.C., is of exceptional interest, not only on account of the singularly rich treasure of objects of high artistic merit in gold, silver, copper, and semi-precious stone, but also for the remarkable burial of a dancing girl which was found in one corner of the building. The body was laid out in dancing pose, with silver rings on the fingers, copper rings in the ears, long coiled armlets, a necklace of effigies of turtles in lapis and silver and a little copper lion, silver tubes, lapis beads, and other objects and ornaments in metal and stone. The mere catalogue of the finds calls up an intriguing picture of the magnificence of this early eastern court, of which, however, the significance will be much enhanced when something more is known of its cultural and artistic affinities.

Mohenjo-Daro Ideographs

A BOLD and entirely speculative attempt to arrive at the meaning of the pictographic designs on the seals found at Mohenjo-Daro, in the valley of the Indus, is made by Sir Flinders Petrie in the course of a notice of the recently published account of the excavations on this site by Sir John Marshall, which appears in *Ancient Egypt*, 1932, pt. 2. Sir Flinders Petrie justifies his method of attacking the problem by taking the ideographic signs in their primary sense of 'pictures' expressive of ideas, on the grounds, first, that being engraved on stone they escaped transformation and retained their original detail, thus being comparable with the ideographic method of Egypt; and secondly, that the study of official titles and the method of writing them in Egypt has supplied parallels to what may be discerned in India. Thus the recurrence of a number of strokes suggests that parallel to an Egyptian 'Home of Four', 'Five Men', and the like, we have a 'Hall of Four', 'Hall of Six', etc., pointing to a system of naming officials by the number holding office, like the Duumviri, Decemviri, etc., of ancient Italy. There is evidence for this method in Cappadocia. Another set of signs consists of wheels with six or four spokes, that is, chariots and wagons, signifying transport. 'Timber', 'water supply', 'an army', 'game', or 'hunting' are meanings suggested for other symbols, which, in combination with other signs suggesting authority, are interpreted as the designation of officials connected with departments of State; thus, 'Officials of the Registry of Chariots'. Nearly one-half of a hundred symbols are interpreted tentatively on the presumption that they are certainly ideographic signs such as lie at the base of Egyptian, Sumerian, and Chinese writing, but at so early a stage that the forms can mostly be recognised.

The 'Historical Society of Science', 1841

IN *Isis* for July 1932, Mr. H. W. Dickinson gives an account of the Historical Society of Science founded in London in 1840 by J. O. Halliwell and Thomas Wright. Halliwell, who was born in Chelsea on June 21, 1820, and died near Brighton on Jan. 3, 1889, was a most remarkable man, and even as a boy had a passion for collecting MSS. He matriculated from Trinity College, Cambridge, in 1837, and before he was twenty years old had written a life of Samuel Morland and edited Sir John Mandeville's "Travels". In 1839 he was elected F.S.A. and F.R.S. The prospectus of the short-lived society for the study of the history of science said that its object was "to render materials for the history of the Sciences accessible to the general reader, by the publication of manuscripts, or the reprinting of very rare works connected with their origin and progress in this country and abroad". The Duke of Sussex became the president of the Society, and on the council were de Morgan, Palgrave, Baden Powell, Gardner Wilkinson, Prof. Robert Willis, and others. But though its start was an

auspicious one, the Society had but a short life and came to an end within a year. Halliwell—or Halliwell-Phillipps as he was called in later life—was a great writer on Shakespeare. He arranged and described the Stratford-on-Avon archives and initiated the movement for the purchase of the site of New Place, Shakespeare's residence there.

Whales Stranded in Scotland

SCOTLAND is favoured by the number of whales and whale carcases which are deposited upon its shores, and although this accident of position involves the expenditure of dealing with unsavoury nuisances, it has its scientific value. Accordingly a memorandum has been addressed to Scottish medical officers of health, sanitary officers, and the like, by the British Museum (Natural History), requesting the co-operation of these local officers in recording the stranding of whales, porpoises, and dolphins. Whenever a whale is stranded upon the British coast, a telegram, followed in due course by a detailed report, is sent to the Museum by the receiver of wreck or coastguard, and the Museum telegraphs to the sender to let him know whether the whole or any part of the whale is wanted, either for purposes of identification or for preservation. In this way much valuable information has been gathered in recent years regarding the cetaceans frequenting British waters and their seasonal movements; and the present memorandum aims at extending the scheme of notification. It states that as a rule a few days' delay does not affect the condition of a stranded whale, that a small whale killed by stranding can lie on a beach for as much as three weeks without giving rise to any serious nuisance and without entailing the slightest risk of infection, and that carcases moored in the water will keep quite well for as long as seven weeks. It is also pointed out that in this matter the British Museum is working in co-operation with the Royal Scottish Museum, Edinburgh, and that an eventual sharing of the specimens between the two museums has been arranged.

Protection of the Grey Seal

THE Fishery Board for Scotland has issued a notice directing the attention of fishermen and others to the provisions of the Grey Seals Protection Act of 1932. By that enactment a close time exists, between Sept. 1 and Dec. 1 inclusive, for the taking of grey seals (*Halichœrus grypus*). Any person taking, killing, or wounding any grey seal within the above-mentioned close season is liable on summary conviction to a penalty not exceeding £5, and any owner, master, charterer, or hirer of a boat, using or permitting his boat to be used for the purpose of taking, killing, or wounding grey seals during the close season, is liable on conviction to a penalty not exceeding £10.

Animal Groups in Philadelphia Museum

REGARDING our comment about the incongruous grouping of small mammals in certain cases in the Museum of the Academy of Natural Sciences of Philadelphia (July 16, 1932, p. 90), Mr. Leigh Mitchell Hodges, public relations director of the Academy, writes to say that the sole purpose of the cases in question was to bring together the outstanding examples of the small mammals common to Pennsylvania and New Jersey. No effort was made to exhibit them in their natural surroundings, the grouping being simply a convenient aggregation primarily for the education of school children. Nevertheless, the introduction of a certain amount of ' environment ' might suggest to children the definite association in Nature of species not usually found together, and this possibility is what we had in mind. In the Museum as a whole, as is well known, great progress has been made in the development of habitat groups, the large cases illustrating lions, Kodiak brown bears, Stone's sheep, and Rocky Mountain goats being particularly fine examples of such exhibits. During the present year, groups of musk-oxen and whistling swans have been constructed, and the programme for the future includes cases of the giant sable antelope, African animals at a water-hole, and the giant panda of Tibet.

Hancock Museum, Newcastle-upon-Tyne

THE Council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne has decided to issue an occasional museum bulletin, with the view of keeping members and associates in closer touch with the activities of the Society and the Museum. The first number of the *Bulletin* contains short paragraphs directing attention to the summer field meetings of the Society, the Museum wild-flower exhibit, and the new arrangement of the Abel Chapman collection of big game trophies and birds of prey. A curious addition to the collections is a hybrid between an English pheasant cock and a white Wyandotte hen, much larger and heavier than an ordinary pheasant, but very pheasant-like in carriage and shape and in the plumage of head, neck, back, and sides. Legs and feet follow the domestic fowl pattern, and the right leg bears a short spur. The bird tasted more of fowl than of pheasant. It is matter for regret that the increase of goldfinches in parts of Northumberland and Durham has attracted the professional bird-catcher, so that the beautiful birds are again threatened with extinction. A strong appeal is made for an increase in membership, so that the good work of this century-old Society may be continued unabated.

B.D.H. Book of Analytical Reagents

A SECOND, revised, and enlarged edition of " The B.D.H. Book of A.R. Standards " has been issued (price 2*s.* 6*d.* net; postage 6*d.* extra) by the British Drug Houses, Ltd., Graham St., City Road, London, N.1. Fifty new substances have been added to the 158 chemicals in the first edition, and the limiting values of the various tests have been stated at the head of each section in the form of a table which represents the maximum permissible limits for the various impurities. We may remind readers of NATURE that the letters A.R. (replacing the unsatisfactory description " Chemically Pure ", or C.P., an unattainable ideal) denote analytical reagents of controlled and specified purity, and users of such reagents will thus be able, by means of this monograph, to judge what impurities may possibly be present and in what amounts. It is clear that, with improvement in analytical chemistry, some of the specifica-

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tions may be given still further precision in future editions. The entry under copper oxide, for example, on p. 62, which returns nitrate, carbonate, and organic matter as "nil" on the basis of a rather crude test, is obviously capable of revision, and other cases will no doubt suggest themselves to the reader. For routine work, as distinguished from research, these specifications will be of considerable value, and the book will be found useful in all analytical laboratories.

Refractories

WE have received from Messrs. John G. Stein and Co., Ltd., of Bonnybridge, Scotland, an interesting catalogue of refractory materials, dealing with various grades of firebricks, silica bricks, cements, retorts, etc. This firm has an output of one million refractory bricks weekly. All the clays required are obtained from the firm's own mines, and throughout the process of manufacture every factor is scientifically controlled, thus ensuring uniformity of products. The catalogue, which is well produced and illustrated in colour, gives a number of useful tables and formulæ, together with lists of the principal uses of the products. It contains some phase rule diagrams, for example, of the forms of silica and of the system $SiO_2 - Al_2O_3$, and a glossary of terms relating to silica and fireclay refractories. Special shapes will be made when required, the manufacturers being willing to co-operate in producing a satisfactory result in such cases. This catalogue is of a type which deserves every commendation, since it indicates a close co-operation of scientific and technical knowledge and a realisation of the importance of research in maintaining the quality of the products and in making progress in new directions, which are most encouraging.

Non-Ferrous Metals Research

THE twelfth Annual Report of the British Non-Ferrous Metals Research Association shows that in spite of the industrial depression, progress has been well maintained. With a Government grant of £8000, the total income has been brought up to more than £25,000, proving that the industry has found the work of the Association of increasing value. In June 1931 the new headquarters in Euston Street, London, N.W.1, were opened, and visitors have been able to see how well the limited space available has been utilised for experimental work, and for the equally important work of collecting information and making it accessible to members. A study of the methods of the Association in this field would provide lessons for other research organisations, especially for such as have to make their results intelligible and serviceable to manufacturers, many of whom may have no adequate scientific staff to interpret the conclusions of the research workers. The subjects under investigation include many which are of interest to workers in pure science as well as to industrialists, and the results of these are usually communicated to a scientific society after they have been circulated to members. Whilst several of the investigations are now carried on at headquarters with the help of the equipment recently installed there, much research of importance is also in progress for the Association at the National Physical Laboratory, the Research Department at Woolwich, the University of Birmingham, and elsewhere.

Organisation of Living Things

IN a short article in *Scientia* (Aug. 1932, p. 84) Dr. J. Needham discusses the problem of organisation and its place in the biological thought of the present day. Organisation is a property of all matter, and the organisation of living things is at one with material organisation, even if on a grade of its own. It is not something which controls or directs the material system, but is bound up with, and inseparable from, the organised matter itself. From this point of view organisation in the biological sense is something integral with the rest of scientific data, which science can take into account; and it will probably make necessary a widening and stretching of the classical concepts of physics and chemistry rather than an abandonment of them, so that a new mechanism will be evolved to include the modes of action and the organising relations found in living systems. Herein lies the central problem of biology, and biology will make progress only when, as has happened in physics and chemistry, attention is given to the theoretical principles which underlie and would co-ordinate the multifarious studies and researches of the field and the laboratory.

International Co-operation among Agricultural Brain-workers

UNDER the above title the Czechoslovak Academy of Agriculture has recently published in book form—in French, German, English, and Czech—the proceedings of a meeting of its corps of foreign members held at Prague on June 3, 1931, a matter which has already been referred to in this journal (**128**, 597; 1931). On this occasion detailed proposals were put forward by Dr. Reich, the secretary-general of the Academy, for furthering the international co-ordination of scientific and intellectual effort as applied to the agricultural domain. Among these was the original suggestion that an international 'Nobel prize' of the annual value of 1,000,000 Czechoslovakian crowns (approximately £8333) should be founded and awarded for the best piece of scientific work in agriculture. In this way it is expected that two important results will follow. In the first place, definite financial recognition can be awarded to investigations of outstanding merit. In the second place, an annual award of this character cannot fail to exercise a great moral and intellectual stimulus on the future development of agricultural science. An international committee, consisting of eighteen members, has been appointed to work out the details of the scheme and to collect the capital sum needed. In view of the fact that the welfare of industry is intimately bound up with that of agriculture and that in the future both must stand or fall together, it should not prove an impossible task for the nations to endow such a 'Nobel prize' for agricultural research.

British Association of Commercial Seed Analysts

THE seventh Conference of the British Association of Commercial Seed Analysts was held on July 21 at

the National Institute of Agricultural Botany, Cambridge. The president, Mr. A. E. Birks, stated in his address that members are continuing to avail themselves of the facilities afforded by the Association, and during the year a number of interesting experiments were carried out by members working together. In one case, tests were made on a particularly difficult sample of asparagus kale in an endeavour to arrive at an equable result. The wide divergence in results obtained proves that there still remain factors governing the germination of this seed which are not fully understood. Mr. Harding gave an address on the comparison of soil and laboratory tests. He considers that soil tests properly carried out are of real value in estimating the maximum percentage of plantlets that can be obtained under field conditions. In some instances, when working upon new seeds, results from the laboratory and the soil tests are identical: greater differences occur when old seed is being tested. Finally, soil tests are certainly helpful when made in conjunction with the laboratory, as they assist in revealing discrepancies. The following officers were elected for the coming year: *President*, Mr. E. B. Wallace; *Vice-President*, Mr. A. E. Birks; *Hon. Secretary and Treasurer*, Mr. F. H. G. Neale, "Emmandee", Hawthorn Gardens, Reading.

Annual Report of the Ministry of Health

THE thirteenth Annual Report of the Ministry of Health, 1931–1932 (H.M. Stationery Office. 5*s*. net), recently issued, is in the main a record of the more important business transacted by the Ministry during the year, and does not cover matters of routine or detail, the Annual Report of the Chief Medical Officer of the Ministry being published separately as in previous years. Allusion is made to the British Post-graduate Hospital and Medical School, now in process of formation, for which a grant of £250,000 had been previously contemplated, but for which Parliament will now be invited to contribute a maximum grant of £100,000 in view of the exigencies of the time. The National Radium Trust has made further purchases of radium, and now owns a little more than 17 gm. Local authorities have been active during the year in the sewering of their areas, and loans sanctioned during the year amounted to nearly $7\frac{3}{4}$ million pounds. Other subjects dealt with in the Report fall under the main heads of public health, housing and town planning, local government and finance, poor law, and national health insurance.

Library of Educational Films

THE Empire Marketing Board has published a new edition of its film library catalogue, and copies are obtainable free on request from the Board, 2 Queen Anne's Gate Buildings, London, S.W.1. A great variety of films illustrating different aspects of scenery, natural history, and economic activity is now available. These cover most parts of the Empire. An important addition to the list is a series of class-room films, which are intended for the use of teachers rather than for general circulation. There are about forty of these films, some of which are travel surveys, while others deal with such subjects as canals, irrigation, cotton, wool, water power, or social life. All the films are available free for approved displays at which there is no charge for admission. Carriage must be paid by the borrower.

Cancer Mortality in the United States

DEATHS from cancer have increased alarmingly throughout the United States of America in the past year and a half, in the face of extremely favourable general health conditions. Science Service, of Washington, D.C., notes, under date Aug. 9, that figures compiled by the Metropolitan Life Insurance Company upon its industrial policy holders show a rise of 7·4 per cent in 1931, and for the first half of 1932, a further rise of 9·5 per cent over the rate for the like part of last year: the average rise in the period 1919–1930 was 1·5 per cent a year. Although official mortality statistics are not yet available for any large part of the country, the provisional reports are said to substantiate the Metropolitan figures.

Announcements

MR. WILFRED TROTTER has been appointed a member of the Advisory Committee on the Administration of the Cruelty to Animals Act, 1876, in succession to Sir Arthur Keith, who has resigned.

DR. JAMES LAW BROWNLIE has been appointed by the Secretary of State for Scotland chief medical officer of the Department of Health for Scotland in succession to the late Dr. John Parlane Kinloch.

THE annual exhibition of the Professional Photographers' Association was opened at the Princes Galleries, Piccadilly, London, W., on Sept. 5, and will remain open until Sept. 29. The exhibits comprise industrial photography as well as portrait work.

DR. HAROLD MOORE, who has for many years been director of metallurgical research at the Research Department, Woolwich, has been appointed, as from Oct. 1, director of the British Non-Ferrous Metals Research Association, to succeed Dr. R. S. Hutton, who has been elected to the new Goldsmiths professorship of metallurgy at the University of Cambridge.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mechanical engineering at the Swindon Technical College—The Director of Education, Education Office, Clarence Street, Swindon (Sept. 24). Inspectors for the purposes of the Diseases of Animals Act, 1894–1927, in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Sept. 26). An assistant lecturer in engineering and a lecturer in production engineering at the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (Sept. 29). A lecturer in pure mathematics at the Wimbledon Technical College—The Principal, Wimbledon Technical College, Gladstone Road, S.W.19. A science master (chiefly physics) at the Prince of Wales' Indian Military College, Dehra Dun, United Provinces, India—The Secretary, Military Department, India Office, London, S.W.1.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Late Geological History of British Somaliland

DURING an expedition to explore the geology of British Somaliland, extending to 19 months spent there in 1928–30, much of the country was seen, with the possibly important exception of the coastal strip east of Berbera. It is hoped to publish the geological and palæontological results in due course, and specialists are now working out the fossil collections. The following details noted incidentally may help to supplement Dr. Parkinson's account of the late climatic changes.[1]

A most instructive district is the Bihendula-Dagah Shabell-Daban area[2] (within 40 km. south-south-east of Berbera), where the following succession was found.

1. *Daban Conglomerate*: Some buff shales and conglomerates with boulders and pebbles of Auradu Limestone (Lower Eocene); 111 m. thick in the Biyo Gora Section. In the Rhabka Hills, 6 km. farther east, it includes flint bands and a silicified band with a species of freshwater gastropod, ostracod marls, and fossil wood; thickness at least 270 m. The age is not at present known: it forms the top of the 2300 m. thick Daban freshwater series, which has an intercalation of fossiliferous marine Middle Eocene beds near the base. During its formation, a fault cliff appears to have existed south of the great east-west Dagah Shabell fault, whence fell enormous masses of Auradu limestone, including that of Agagwein, 1100 m. long, the Leopard Rocks, 190 m. long, and many of lesser size; these are embedded in the Daban Conglomerate.

2. *Posthumous Faulting* in the Gulf of Aden trend then took place along the Dagah Shabell fault and affected the Daban Conglomerate.

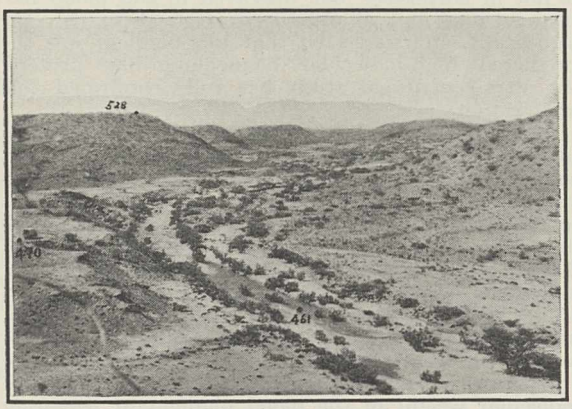

FIG. 1.—Terraces at Dagah Shabell, British Somaliland, looking south-west. Altitudes in metres. Motor truck by point marked 470 gives the scale. Golis Range in far distance.

3. *The Older Boulder Beds*, largely of Auradu limestone, were next deposited over the area, the material being derived from the high ground to the south. Traces of them are now found up to an altitude of 594 m. at Daghani (east of Bihendula), where one patch lies undisturbed across the Dagah Shabell fault. Immediately south of Dagah Shabell they are better preserved at rather lower levels (Fig. 1, at 528 m.).

4. *Erosion*: A drainage system independent of the underlying solid geology was then established on this gravel-covered area, and during what must have been a long-continued wet period almost the whole of the

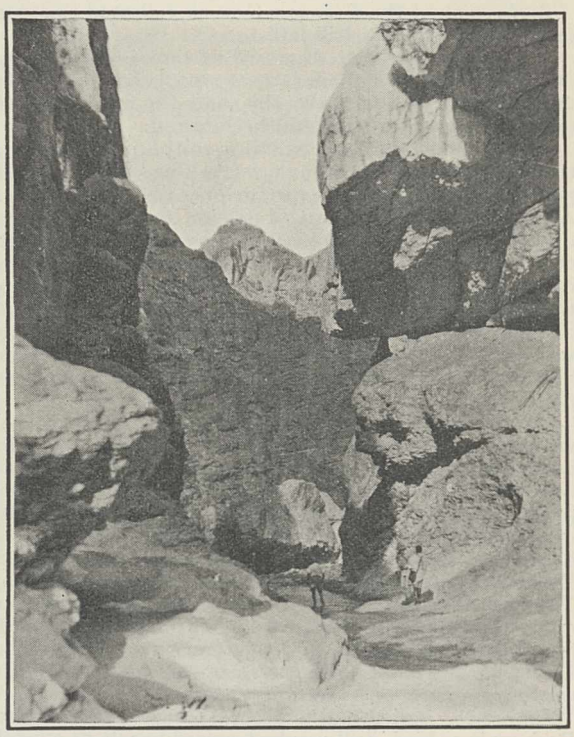

FIG. 2.—Gorge of the Biyo Gora Tug, British Somaliland, looking north (downstream). Walls of downfaulted Auradu (Lower Eocene) Limestone; in background Nubian (Cretaceous) Sandstone.

Older Boulder Beds were eroded from the Bihendula–Daghani area, and the underlying strata deeply cut into by several tugs, which flow almost due north, in a most spectacular manner. Across the strike and against the dip of these beds, which is steadily about 18° south, the superimposed Daghani Tug has cut narrow gorges through three hard Jurassic limestones, 244 m., 103 m., and 80 m. thick respectively, separated by two shales 250 m. and 113 m. thick (the outcrops of which are now occupied by strike valleys), through the Adigrat (? Triassic) Sandstone, 200 m. thick, the Archæan Igneous and Metamorphic basement (in which the narrow gorge is up to 60 m. deep), and, across the fault, through the concrete-like Daban Conglomerate. The Bihen Tug, at Bihendula, has cut a very similar course. The Biyo Gora Tug has cut a vertical-walled gorge only some 10-20 m. wide through the hard and massive Auradu Limestone of the Ali Wein Range (Fig. 2). These gorges were not cut along fault lines.

5. *The Younger Gravels* were next deposited in the valleys (Fig. 1, at 470 m.). These are mainly of Archæan igneous pebbles, but contain some of Auradu Limestone, and are locally largely made up of reworked Nubian Sandstone and Shabell Beds (Cretaceous). A small tug cut in the Nubian Sandstone was found at Dagah Shabell completely infilled with Younger Gravel, and so not functioning in the present drainage system. During this period were deposited curious nests of Archæan boulders, two of which were found 4 km. and 8 km. respectively south-west of

Dagah Shabell. These boulders comprise an assortment of granitic types and are well rounded; the largest measured about 5 m. × 3 m. × 2 m., and must weigh some 70 tons.[3] The nests are not found in the present-day tugs but on the gently undulating gravel plain. The boundary of the nearest Archæan outcrop lies 11 km. and 7 km. respectively to the south-west.

6. *Erosion* of the Younger Gravels followed to some extent, but much is still left.

A thickness of 45 m. of gravel was measured resting on the Daban Conglomerate at one point, but it is uncertain to which phase this and the gravel cover over the Daban area should be referred.

Phase 6 may be that existing at the present day; the intermittent erosion now taking place would probably be adequate to produce the observed effects. A measure of the amount of erosion since the deposition of the Daban Conglomerate is given by the remnant of the Auradu Limestone cliff from which, if I am right, fell the great masses of limestone now found in that conglomerate on the north side of the Dagah Shabell fault. The three remaining fragments are seen in the Auradu Hills, 11 km. south of the Dagah Shabell fault, and rising perhaps 100 m. above the plain.

Evidence from the coastal district shows that various changes in the level of the land had meanwhile been taking place. At Dubar, 12 km. south of Berbera, at an altitude of 200 m. were found fossils which proved to be of an age not greater than Pleistocene, indicating a poorly marked raised beach. A series of limestone knolls 3-4 km. south-west to south-east of Berbera lie at altitudes of between 50 m. and 85 m. They are fossiliferous, but the hard limestone is much cut and polished by the sand-blast of the Kharif (south-west monsoon), and no fossils were collected. However, an older collection appears to have been made from here, and the fauna is again not older than Pleistocene, indicating a second raised beach. At Berbera is a third, well-marked, raised beach, at a level of 8 m. A correlation between raised beaches and gravel terraces was not possible, since in no case were the two found together: further search may remedy this.

Along the coast between Zeila and Bulhar, and again somewhat inland east and south-east of Berbera, are sand dunes of limited extent. In the latter area they are often of a reddish colour and clearly derived in part from the Nubian Sandstone on which they sometimes rest. They probably belong to the present-day period.

My thanks are due to the Somaliland Petroleum Co. Ltd. for permission to publish this note.

W. A. MACFADYEN.

Sedgwick Museum,
Cambridge,
Aug. 10.

[1] NATURE, **129**, 651; 1932.
[2] See A. Beeby Thompson and John Ball, "Report on the Daga Shabell Oilfield (British Somaliland)". Govt. Press, Cairo, 1918.
[3] Cf. *Geog. J.*, **72**, 416; 1928.

Molecular Weights of the Blood Pigments of *Arenicola* and of *Lumbricus*

IN a letter to NATURE of June 8, 1929, p. 871, one of us directed attention to the fact that all stable native proteins may, with regard to molecular weight, be divided into two large groups: the hæmocyanins with molecular weights of the order of millions, and all other proteins with molecular weights from about 35,000 to about 200,000. Among the proteins considered in that letter were three respiratory pigments, namely, the hæmoglobin of the vertebrates with a molecular weight of about 68,000, and two different hæmocyanins—that from the blood of *Helix*, possessing a molecular weight of about 5,000,000, and that from the blood of *Limulus*, of about 2,000,000.

We have recently had the opportunity to study the hæmocyanin from the blood of *Octopus* and have found it to be very different from the two hæmocyanins just mentioned, although of about the same molecular weight as the *Limulus* hæmocyanin. The sedimentation constant is higher and the shape of the molecule less asymmetrical. A few preliminary runs on chlorocruorin from the blood of *Spirographis* have further indicated that this respiratory pigment, like the hæmocyanins, has a molecular weight of the order of millions. With regard to the active group of the molecule, chlorocruorin is more allied to hæmoglobin than to the hæmocyanins, its characteristic element being iron and not copper. The fact that an active group containing iron and of semi-hæmin type is here associated with a protein carrier of about the same mass as the hæmocyanin molecule has led us to consider the possibility that there might exist other respiratory pigments of molecular mass of the order of millions but with the hæmin group of the hæmoglobin of the vertebrates.

If such respiratory proteins exist, they would most likely occur in the blood of the lower animals. Now, it is well known that several worms and molluscs have red blood. As a rule, the respiratory pigment of these animals is not in corpuscles but is in solution in the blood. This red protein has hitherto been considered as a form of hæmoglobin. J. and H. Barcroft have made a very thorough study of the absorption spectrum and of the affinities for oxygen and carbon monoxide of the blood pigment of *Arenicola*.[1] They arrive at the conclusion that the pigment is "of the same general type, but different in detail from that of human blood". We quite agree with these authors that the spectroscopic evidence as well as the behaviour of the pigment towards oxygen and carbon monoxide prove that its active group closely resembles hæmin, but this does not necessarily mean that the mass and the chemical properties of the protein part of the molecule are the same as those of the hæmoglobin of the vertebrates. The fact that it is not in corpuscles but dissolved in the blood like hæmocyanin and chlorocruorin seemed to us very significant, and suggested that this pigment was the predicted high-molecular hæmoglobin-like protein. An ultra-centrifugal study has fully confirmed this supposition.

Blood from *Arenicola marina* which had been kept in ice for about two days was diluted with a 1 per cent solution of sodium chloride and the sedimentation velocity of the molecules measured at 20°. It was found to be beautifully homogeneous with regard to molecular mass, and gave a sedimentation constant of 60×10^{-13}. This is not far from the value of the sedimentation constant of *Octopus* hæmocyanin, namely, 45×10^{-13}, and from that of *Helix* hæmocyanin, namely, 98×10^{-13}, but is of quite a different order of magnitude from the sedimentation constant of the vertebrate hæmoglobin, which is $4{\cdot}4 \times 10^{-13}$. The molecular weight of the blood pigment of *Arenicola* is therefore of the order of millions.

For the sake of comparison, a determination was also made with blood from *Lumbricus* collected immediately before beginning the run. The sedimentation constant of the respiratory pigment was found to be 68×10^{-13}. It is possible that the *Arenicola* blood used for the determination of the sedimentation constant may have decomposed slightly during the time between collecting and centrifuging it, and that therefore the value of the sedimentation constant of quite

fresh *Arenicola* blood is somewhat higher. But even if allowance be made for this slight uncertainty, we believe that there remains a real although small difference between the sedimentation constants of the blood pigments of *Arenicola* and *Lumbricus*.

The fact that not only the hæmocyanins but also other respiratory pigments in the blood of the lower animals have molecules of enormous mass seems to us very remarkable. It would be of considerable interest to try to find out at what stage of evolution the normal hæmoglobin appears, and whether its existence is exclusively connected with the formation of blood corpuscles. Perhaps hæmoglobin with its comparatively low molecular weight is strictly limited to the blood of the vertebrates, and the very high molecular weight respiratory pigments to the blood of the invertebrates. A study of the molecular weights or the sedimentation constants of the blood pigments throughout the animal kingdom might serve to throw light upon the relationships of the various classes of animals and upon their relative age.

THE SVEDBERG.
INGA-BRITTA ERIKSSON.

Laboratory of Physical Chemistry,
University of Uppsala,
July 30.

[1] *Proc. Roy. Soc.*, B, **96**, 28; 1924.

The Limiting Mobilities of some Monovalent Ions and the Dissociation Constant of Acetic Acid at 25°

MACINNES, Shedlovsky, and Longsworth [1] claim to have obtained accurate figures for the limiting mobilities of certain monovalent ions, *inter alia*, K^+, 73·50; Na^+, 50·10; H^+, 349·72; Cl^-, 76·32; CH_3COO^-, 40·87; and they refer to the discrepancies between these and the older figures compiled by Noyes and Falk.[2] We would point out that all these constants, except that for the acetate, were determined by us some time ago,[3] and were based on the use of the Ferguson and Vogel method [4] for extrapolation to infinite dilution and a value of 0·490 for the cation transport number for potassium chloride; our figures are K^+, 73·4; Na^+, 49·8; H^+, 348·0; Cl^-, 76·4, that for the hydrogen ion being based on conductivity measurements of iodic, hydrochloric, and benzenesulphonic acids in dilute solution in silica cells.

We have recently carried out conductivity measurements on sodium and potassium acetates and have corrected the results for hydrolysis by a method which is of general application; our figure for the mobility of the acetate ion is 37·85. New determinations of the conductivity of acetic acid over the concentration range 0·0001 – 0·01*N* in silica cells of the Hartley and Barrett type gave the value of $1{\cdot}776 \times 10^{-5}$ for the true or thermodynamic dissociation constant of this acid. This is much higher than the figure $1{\cdot}753 \times 10^{-5}$ obtained by MacInnes and Shedlovsky.[5] Full details of these results will be published in the near future.

A. I. VOGEL.

Woolwich Polytechnic, London, S.E.18.

G. H. JEFFERY.

University College, Southampton.
Aug. 27.

[1] *J. Amer. Chem. Soc.*, **54**, 2761; 1932.
[2] *J. Amer. Chem. Soc.*, **34**, 454; 1912.
[3] *J. Chem. Soc.*, 1715; 1931: 400; 1932.
[4] *Phil. Mag.*, **50**, 971; 1925.
[5] *J. Amer. Chem. Soc.*, **54**, 1429; 1932.

Structure of Polished Solids

IN consequence of the recent communication of R. C. French [1] on the structure of polished surfaces —investigated by high-speed electrons—and the fact that at the same time W. Boas and E. Schmid,[2] using Laue reflection diagrams, come to rather different conclusions, it seems desirable to mention some of the results, obtained on different experimental lines and published in Holland about a year ago.[3] These latter results suggest that polishing should be considered primarily as a very fine process of abrasion of the suitably prepared surface, accompanied by a levelling of surface lamellæ (or micellæ), the first step in this direction already being made when grinding the specimen (plastic deformation in the surface layers).

Delicate polishing leads, *inter alia*, to a dragging of minute particles along from the surface, the size of the detached aggregates of atoms ranging mainly in the case of most common hard metals at room temperature from about three to about thirty atoms.[4] Now it is well known that, in the region of dimensions of this size, the properties of aggregates show an exceedingly large variation with particle size. One must therefore consider the process which yields such aggregates—in spite of their very small dimensions—as still being essentially different from a 'molecular' process.

The amicrons [5] concerned may be made discernible ultramicroscopically by means of suitable physical development (Daguerre, Houllevigue, Stern, etc.). A part of the originally detached particles, however, fills up existing pits in the surface and recombines with it (by a process of adhesion, as well established in previous work of the late Sir G. Beilby). The mechanism of polishing always occasions the formation of a surface film ('skin') which largely differs in properties from the underlying material ('core').

The polishing of glass meets with a complication as a consequence of the presence of a eutectic rich in alkali embedded in a framework rich in silica. The soft alkali is the more easily removed part; [6] moreover, that part of the detached particles which is richest in silica—being chemically inactive and fitting easily into the surface pits—adheres best to the surface. In this way a more resistant form of surface-film may be produced.

According to H. Zocher and K. Coper,[7] even such delicate working as the one-directional rubbing of a very hard body, such as quartz, with, for example, a piece of cotton wool, gives rise to a surface anisotropy, as a consequence of deformation, ranging to depths below the surface which are large in comparison with molecular dimensions. Heating may occasion a disappearance of the surface anisotropy, depending on the time of heating and the maximum temperature applied, in a way which agrees with general rules as already given some time ago by W. Reinders and L. Hamburger,[8] who investigated the microscopical, ultramicroscopical, and electrical behaviour (resistance) of thin metal and salt films under varying conditions of film thickness, film backing, mode of preparation, temperature, effect of catalysts and chemical agents.[9]

The carefully polished surface films of crystalline materials—prepared and kept at a temperature far below the melting point—consist of lamellæ of levelled crystallites of non-microscopic dimensions which show a frequency distribution of particle size. These films ordinarily pass into the core material via a transition layer of relatively great thickness, along which the structure and texture show a *continuous* change.[10] The nature of polished surfaces is, more-

over, complicated as a consequence of its general physical metastability ;[11] further, through the adsorption of foreign substances, the occasional occurrence of embedded abrasives (rouge, etc.), and the presence of more or less disturbed boundaries of contact between the minute particles. The importance of the latter factor is, of course, more pronounced than in the case of relatively coarse-grained materials, where the intergranular surface of contact is only a relatively small one.[12]

L. HAMBURGER.

Leuvensche str. 108,
Scheveningen (Holland),
July 21.

[1] NATURE, **129**, 169 ; 1932.
[2] *Naturwiss.*, **20**, 416 ; 1932.
[3] L. Hamburger, *De Ingenieur*, **46**, W, 91-98 ; 1931.
[4] L. Hamburger, Paper read before the Colloid Section of the Netherl. Chem. Ver. at the meeting of May 28, 1932 ; in print.
[5] See R. Zsigmondy, "Zur Erkenntnis der Kolloide", p. 87 ; 1905.
[6] L. Hamburger, *Proc. Kon. Ak. v. Wet. Amsterdam*, **21**, 1066 ; 1918. T. Haigh, Report Brit. Sci. Instr. Res. Ass. 1921 ; J. W. French, NATURE, **110**, 97 ; 1922.
[7] *Z. phys. Chem.*, **132**, 295 ; 1928.
[8] *Proc. Kon. Ak. v. Wet. Amsterdam*, 1916, 1917.
[9] See also *Rec. d. Trav. chim. des Pays-Bas* (4), **12**, 351, 441, 475 ; 1931.
[10] In case of more severe forms of cold-working, complications occur. See W. G. Burgers, *Z. Phys.*, **58**, 11 ; 1929.
[11] Spring, 1903 ; E. Cohen, 1910.
[12] See L. Hamburger, *Ann. d. Phys.* (5), **10**, 789, 905 ; 1931 : **11**, 40 ; 1931.

Mechanism of the Action of X-Rays on Living Tissues

CHEMICALLY, nothing definite has been known on the action of X-rays. This lack of knowledge has led to their use where the benefits of X-irradiation are problematic. X-ray dosages, too, must be set empirically owing to inability to measure in any way their immediate effect on the cells. Even after waiting a week or ten days, only the gross effects can be determined.

From certain theoretical physical considerations based upon cellular oxidations and reductions of the redox type, it occurred to me that, when tissue was irradiated with X- or γ-rays, a definite amount of hydrogen should be evolved. This hydrogen should be rapidly diffused through the tissue walls, and thus could be measured.

A detailed explanation of the hypothetical assumptions made previous to this experiment will follow as soon as certain quantitative data are available. Such data, I hope, will give a criterion for determining the advisability of using X-rays, as well as definite information on which to base the dosage.

In this experiment a micro-respirometer was constructed, having by far the greater volume of air space concentrated in the middle of a tube. On either side of this air space stop-cocks were placed so that the whole could be dismounted for analysis. The respirometer was used to make sure that the tissues employed were alive, and air was used throughout. In the first case, a small piece (about 0·25 c.c.) of normal human rectus abdominus muscle was placed in Ringer's solution, and irradiated in the respirometer for 45 minutes with X-rays. A tungsten target and a dosage of 90,000 r. units (20 ma. 75 kv.) were used. The gases in the respirometer were then analysed and found to contain 1·6 per cent hydrogen, by volume. In the second and third cases, primary carcinoma of the breast were used, and 1·03 and 1·27 per cent hydrogen were evolved respectively. In the fourth case, primary carcinoma of the rectum showed 0·83 per cent hydrogen. The experimental error in the determination of hydrogen was less than 0·05 per cent by volume. As the volume of gas contained in the micro-respirometer was approximately 150 c.c., 1 per cent hydrogen would be equivalent to 1·5 c.c.

The amount of tissue used in each case was of the same order of size, but was not weighed or measured, as the important preliminary consideration was to establish the fact that both normal and pathological tissues actually gave off hydrogen during X-irradiation. γ-Rays were not used, but should have a similar effect. Controls were then run as follows : (1) the empty respirometer was irradiated to determine whether any hydrogen was given off from the glass ; (2) Ringer's solution was irradiated ; (3) and (4) normal and pathological tissue were allowed to respire freely. The gases in each case were then analysed. All the controls were found to be negative for hydrogen. Of course sodium hydroxide was used to absorb the carbon dioxide produced. This was irradiated in (2) above.

The tissues were all killed after about 25,000 r. units. A control was run on muscle tissue that had been killed by asphyxiation, and no hydrogen was evolved after a dose of 90,000 r. units had been used. This, of course, is significant, inasmuch as the hydrogen comes only from the living tissues. Later quantitative measurement, using normal and pathological tissues from the same area, should prove especially enlightening in view of the relative rates of metabolism. The effect of smaller doses of X-rays, and ascertaining which wave-lengths give the maximum effects, should aid in determining exact X-ray dosages.

The fact that hydrogen is removed from the scene of action in tissue metabolism, I believe, is largely responsible for the killing, or at least reducing, the vitality of the cells. Just how this affects them can probably best be shown through oxidation relationships. This will be discussed in a later paper. Regardless of the precise method of evolution of hydrogen, the fact remains that it does come from somewhere within the tissues.

I wish to express my indebtedness to Dr. N. Rachevsky for his continued help throughout this work, to N. A. Ziegler for making the hydrogen analyses, and to George V. Le Roy for certain physiological data resulting in this experiment. (Preliminary Report.)

V. EVERETT KINSEY.

Westinghouse Research Laboratories,
East Pittsburgh, Pa.,
Aug. 6.

Radiographs of Insects

FINDING no record that radiographs of insects were ever made, last summer we took several hundred radiographs of some forty different species of insects. The X-ray tube, constructed in the laboratory, was of lithium glass, and furnished with a very thin window allowing rays of sufficient softness to be used. 3500 volts was the lowest potential with which this tube could be run, and with this potential the venation of wings was shown very distinctly. During the whole work, potentials ranging from this lower limit to 15,000 volts have been used, according to the size of the insect. The insect was placed directly on the photographic film, which was of the type manufactured by the Eastman Kodak Company for dental work.

As an example of the type of radiographs obtained, a reproduction of one showing a *Hydropsyche* larva is given in Fig. 1.[1] The coiled structure is the Malpighian tubules, while the long, narrow, longitudinal

bands are the silk glands. The Malpighian tubules are shown pure white, indicating that they contain chemical elements of comparatively high atomic weight. Excretion of ingested inorganic salts may be indicated, inasmuch as radiographs of different specimens show various degrees of opacity, from no delineation to complete whiteness of the image.

The digestive system and the tracheal tubes are usually the most pronounced structures seen in the

FIG. 1.—Radiograph of *Hydropsyche* larva. ×3.

radiographs. The digestive tract often contains opaque food matter. In insects having a complicated digestive tract, such as the cricket, the detailed structure of the fore and hind gut stands out distinctly. The musculature and the architecture of the chitinous exoskeleton are well brought out. The fat body often exhibits a granular structure, due presumably to the storage of insoluble excretory products containing a chemical element of comparatively high atomic weight. The reproductive organs are not shown well, except that the male accessory reproductive apparatus and, occasionally, the testes themselves and their ducts are visible (water strider). The venation may be brought out beautifully. As an aid to morphological work in the classification of insects, certain details may be brought out which would obviate the dissection of the insect. An important usage may be in physiological studies, especially of digestion and excretion.

We have received invaluable assistance from Dr. S. I. Kornhauser, of the University of Louisville, during this work, for which we express our gratitude.

HUGO FRICKE.
IRWIN SIZER.

The Walter B. James Laboratory
for Biophysics,
The Biological Laboratory,
Cold Spring Harbor,
L.I., New York.

[1] Other reproductions of our radiographs will be found in the September-October number of *Radiography and Clinical Photography*, published by the Eastman Kodak Company.

Petroleum Bacteria and the Nutrition of *Psilopa petrolei*

IN a recent letter to NATURE,[1] Messrs. Lipman and Greenberg have described a coccus or cocco-bacillus occurring in petroleum obtained from a Californian oil well 8700 ft. in depth, and have stated that it has the power of oxidising petroleum with the production of carbon dioxide. This is an interesting addition to the list of micro-organisms which have been recorded as capable of decomposing paraffin hydrocarbons.[2]

The record is, however, of particular interest by reason of its possible connexion with the nutrition of the petroleum fly, *Psilopa petrolei* (Diptera, Ephydridæ). In 1930, I published[3] an account of the biology of this extraordinary insect, in which I described and illustrated the mid and hind gut of the larva as containing great numbers of a cocco-bacillus. My experiments showed that the fly larvæ, which had previously been supposed to feed on the paraffin itself, were unable to go through their development in the absence of extraneous animal matter such as the bodies of small insects; these being frequently trapped in the pools of crude oil where the larvæ live. The experiments did not, however, prove that the larvæ were incapable of deriving *any* nourishment from the oil, which is constantly swallowed, and it was indeed suggested that the bacteria in the proctodæum might be concerned in nutrition, either serving directly as food or by the production of some available substance from the petroleum. This hypothesis appeared all the more probable in view of the great abundance of larvæ in some of the pools contrasted with the apparent scarcity of trapped insects which could be used as food.

In 1931, I obtained some specimens of oil from the Santa Fe Oil Field of southern California, some samples being taken from exposed oil pools, others direct from the wells. These specimens were kindly examined by Mr. J. H. V. Charles of the Division of Biochemistry of the London School of Hygiene and Tropical Medicine. Large numbers of bacteria-like bodies were observed in all samples, although more abundant in those from the exposed pools. First attempts to culture these organisms in pure paraffin hydrocarbons were unsuccessful, but it has now been found possible to grow them in Söhngen's hydrocarbon-ammonium chloride medium at 32° C. The organism first obtained differs from that found in the alimentary canal of *Psilopa*, and from that described by Lipman and Greenberg, in that the bodies are rod-shaped (or fusiform) rather than cocco-bacillary in form. However, Mr. Charles now informs me that, after continued incubation, the cultures show numerous bodies cocco-bacillary in form and exactly similar in appearance to the organism found in the gut of *Psilopa*, although the original larger fusiform bodies are still present in abundance. As yet, nothing has been ascertained as to the metabolism of these bacteria, but work on the subject is being continued, and it is hoped that before long some knowledge as to their mode of life will be forthcoming.

It appears that such organisms are by no means universally present in natural oils, although, according to Söhngen, organisms (bacterium, mycobacterium, micrococcus) capable of oxidising paraffin are easily obtainable from soil. While in Trinidad recently, I obtained a number of fresh petroleum samples from oil wells of varying depth in the neighbourhood of Apex, San Fernando, but in no case were any bacteria or other organisms found.

The abundance of micro-organisms in Californian oil fields may conceivably have some connexion with the ability of an insect to colonise this particular environment—an achievement, so far as is known, unparalleled elsewhere.

W. H. THORPE.

Zoological Laboratory,
Cambridge,
Aug. 23.

[1] **129**, 204, Feb. 6, 1932.

[2] See Söhngen, N. L., 1913, "Benzin, Petroleum, Paraffinol und Paraffin als Kohlenstoff- und Energiequelle für Mikroben", *Centbl. Bakt.*, **37**, 595-608, and Tausz, J., and Peter, M., 1919, "Neue Methode der Kohlenwasserstoffanalyse mit Hilfe von Bakterien", *Centbl. Bakt.*, **49**, 497-554.

[3] Thorpe, W. H., "The Biology of the Petroleum Fly, *Psilopa petrolei*". *Trans. Entom. Soc. Lond.*, **78**, 331-344; 1930.

Diffraction of Electrons in Mercury Vapour

Two years ago, while investigating the angular scattering of electrons in mercury vapour, I found well-marked diffraction effects.[1] In that investigation, results were obtained over an angular range of 18°-126°, and for velocities of the primary electron beam between 8 volts and 800 volts. It was later announced that the work was being extended to larger angles and to other vapours.[2] The apparatus has now been modified to enable results to be obtained for angles up to 175°.

In Fig. 1 some typical results for mercury vapour are shown. An interesting feature of the new results

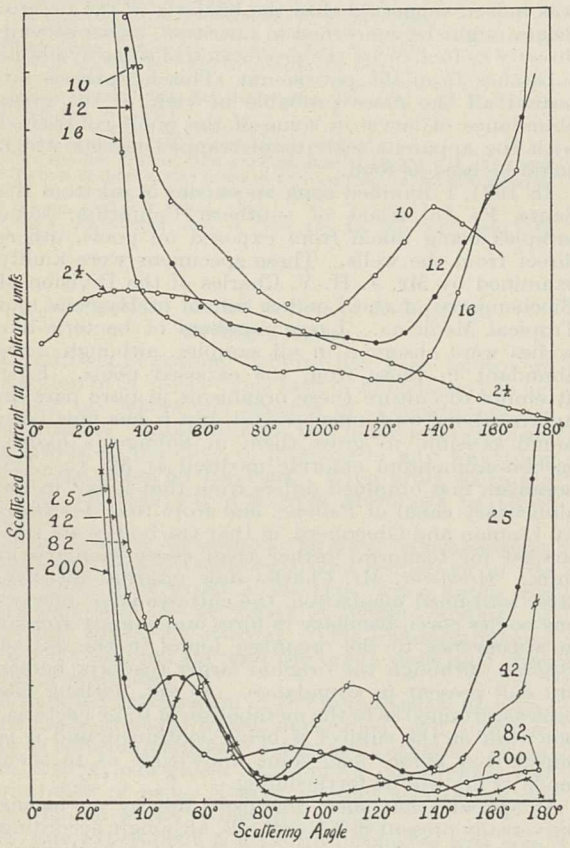

FIG. 1.

is the strong backward scattering of electrons having energies between about 50 volts and 10 volts. This feature has also been found to occur in the rare gases by Ramsauer and Kollath,[3] and in argon by Hughes and McMillen.[4]

In addition to the results given in Fig. 1, curves have been obtained for a number of intermediate voltages. As these curves merely show transition stages between the curves reproduced here, they have been omitted in this preliminary report. A full account of this work will be published shortly, and in the meantime other vapours will be investigated.

F. L. ARNOT.

University of St. Andrews,
Aug. 12.

[1] F. L. Arnot, *Proc. Roy. Soc.*, A, **130**, 655; 1931.
[2] F. L. Arnot, *Proc. Roy. Soc.*, A, **133**, 615; 1931.
[3] Ramsauer and Kollath, *Ann. d. Phys.*, **12**, 837; 1932.
[4] Hughes and McMillen, *Phys. Rev.*, **39**, 585; 1932.

Sir Richard Threlfall and the Automatic Microtome

THE appreciative notices of Sir Richard Threlfall which have appeared in NATURE have made no reference to what was probably his first notable invention;—and one that revolutionised an essential method of biological research. As a contemporary of his at Cambridge, among the first who had the opportunity of profiting by his results, I may perhaps be permitted to emphasise its importance. It had been realised for some time that the structure of an animal could be studied with great advantage with the aid of a complete series of sections arranged in order on microscopical slides. Until 1883 no satisfactory method was known of preparing and mounting such a series. Each section had to be separately placed on the slide, where the material in which it had been embedded was dissolved. Parts of the section which were not connected with others floated away and were lost; and the sections already in place were disarranged, involving the necessity of readjusting many of them before the next section could be added. The work involved was extremely laborious, as I can state from personal experience, and the final result left much to be desired. These were, however, the methods with the aid of which F. M. Balfour established his reputation as an embryologist.

The credit of initiating a more satisfactory process is due to W. H. Caldwell, who ascertained that a section of an object embedded in a block of solid paraffin cut so that two of its edges were parallel to one another and to the edge of the knife to be used could be made to remain united on the razor. An important detail in this method was that the block of hard paraffin used for embedding was dipped, before cutting, in a paraffin of lower melting point, which served as the cement uniting consecutive sections. In 1882, Caldwell consulted Threlfall, then an undergraduate at his own College (Caius), leaving it to him to devise a machine which would produce the desired result. This object was duly accomplished; and the microtome, constructed in Prof. Stuart's workshop at Cambridge at Threlfall's expense, was completed in 1883 and proved an unqualified success. Its history has fortunately been recorded in a very recent paper by Threlfall (*Biological Reviews*, Cambridge, vol. 5, p. 357; 1930), who stated that the only biological work he ever did at Cambridge was the preparation, with his microtome, of a complete series of sections of *Amphioxus*, represented (in part) by a ribbon of sections "some yards long".

The original instrument continued in almost daily use in Sedgwick's laboratory at Cambridge for many years after newer patterns had been invented, giving results equal to those of the best of them; and I think I am right in stating that it was still employed when I left Cambridge in 1908. Threlfall had added one essential improvement to Caldwell's original idea. This was the introduction of a method by which the sections were arranged on slides coated with a dilute solution of rubber, by which they became attached to the slide, so that the paraffin could be dissolved without disturbing any of the loose parts. Slides containing sections prepared by the method of Caldwell and Threlfall can be read like the consecutive pages of a book, instead of, as previously, like an incomplete series of detached pages frequently imperfect and out of order. Biological science has to acknowledge a deep debt of gratitude to Threlfall for designing the first automatic microtome.

SIDNEY F. HARMER.

Melbourn, Cambs,
Sept. 7.

Research Items

Tobacco among Californian Indians.—Knowledge of tobacco and the practice in its use among the Karuk Indians of the Klamath River, California, are recorded, for the most part in their own words, by Mr. J. P. Harrington in *Bull.* 94 of the Bureau of American Ethnology. Literature on this matter among Californian Indians is practically non-existent, and this is the first section of an inquiry among selected tribes in diversified areas of the State. Drake, in recording his visit to what is now presumed to be Drake's Bay, in 1579, mentions "bagges of Tóbah for presents" brought by the Indians. This was *Nicotiana bigelovii* var. *exaltata*, the species now used by the Karuk. The Pomo Indians use *N. glauca*, introduced from South America. Both species now grow wild in this region. Before the restriction of their activities by the whites, the Karuk were typical river Indians, living on rancheros, their food being acorn soup, salmon, deer meat, greens, berries, nuts, and vegetables. Tobacco was cultivated in a simple fashion. In curing, leaf and stems were separated, the latter being pounded to form an inferior kind of tobacco which was used by hunters, priests of ceremony, and doctors as offerings to the Ikxarey, the 'old-time people', who turned into animals, plants, rocks, mountains, and the like, when the Karuk came to the country, and after they had started all customs. The superior tobacco is smoked by men. Women never smoke except when, as doctors, they perform the functions of men. Tobacco is used only for smoking, being chewed only rarely, and never eaten. The pipe is made of wood with a soapstone lining to the bowl, and is sometimes inlaid with abalone. Smoking is practised in the evening only, after the meal. Tobacco-smoke blowing and tobacco tossing accompany all ceremonies and actions in which luck is sought. The thought of the Karuk is so occupied with tobacco, that it enters into the names of places and individuals.

American Prehistoric Basketry.—An attempt to classify the prehistoric basketry of the south-western United States has been made by Gene Weltfish (*Smithsonian Misc. Collec.*, vol. 87, No. 7), notwithstanding the unevenness of the material and the indefinite character of the information relating to some of it. After examination of all the material available from the various sites in the south-western area and its arrangement in accordance with the archæological classification of south-western cultures, it is concluded, in general terms, that certain technical types stand out clearly. In *coiling*, there are three types with triangular foundation elements: basket-maker in two varieties—two-rod-and-bundle-triangular, and two-rod-and-reed-triangular; cliff-dwellers (identical with basket-makers in type, but differing in texture); and a type with three-rod-triangular foundation. One-rod foundation with interlocking stitches occurs with sufficient frequency to be called a type. In sifter coiling there are two types; and in twill plaiting there are two types, the yucca ring baskets being made from the centre of the bottom upwards, and a second form made downwards with the bottom unfinished. The most important implication of the classification is that there appears to be strong evidence of a unified San Juan area in which basket-maker material is concentrated, with more divergent types at the periphery, and one-rod and sifter coiling as perhaps intrusive. The outstanding cliff-dweller types are the close coiled basketry of basket-maker type and the yucca-ring baskets, the latter persisting in modern times at Hopi and Rio Grande Pueblos. The three-rod-triangular foundation is independent of the basket-maker-cliff-dweller complex and may belong to a later horizon. It is identical with the modern coiled basketry of the San Carlos Apaches. The close affiliation of Sikyatki with modern Hopi is supported by basketry evidence. The appearance of a distinct Texas type of coiled basketry south of the Lower Rio Grande probably marks the limit of the prehistoric south-western area.

Helminthes in Man in Rhodesia.—In a helminthological survey of Southern Rhodesia, Dr. W. K. Blackie (No. 5, Memoirs, London School of Hygiene and Tropical Medicine, 1932) records the results of observations made in the Colony in 1930-31. The incidence of helminthic infestations was ascertained by examining both indigenous and immigrant natives and, later, the European sections of the community. Dr. Blackie gives details of the incidence of *Schistosoma hæmatobium* and *S. mansoni* and of the distribution and biology of their respective molluscan intermediate hosts, and records the finding in man (ten cases) of *S. mattheei*, a species described in 1929 from sheep in South Africa, and found by the author in sheep and cattle and in one baboon in Southern Rhodesia. The definitive site of this species in man is the bladder, and the eggs are passed in the urine. Hookworm infestations are present among all sections of the population. The nematode *Ternidens deminutus* was found in about one hundred natives, and an examination of monkeys and baboons along the eastern border of the Colony revealed a high incidence of infection with this worm. The occurrence of *Strongyloides fulleborni* in twenty-four cases appears to be the first record of the natural occurrence of this worm in man. The author concludes that schistosomiasis (especially urinary) is the most important helminthic disease in the Colony and that next in importance are the hookworm infestations.

Improved Anti-Plague Serum.—It was noted in the Report for 1929 of the Haffkine Institute, Bombay, that experimental evidence had been obtained that anti-plague serum prepared by the immunisation of the ox and sheep is more potent curatively than that prepared in the horse. In the Report for 1930 it is stated that an important trial of this new serum on human cases under carefully controlled conditions has been carried out, with encouraging results. Of 43 cases of plague treated with the serum, 15 died, while of 33 similar cases treated on identical lines but without serum, 23 died. In the first series, the recovery of cases with a considerable number of plague bacilli in the blood was noteworthy, and the rapid improvement of others within a few hours of serum treatment was striking.

New West Indian Molluscs.—During an exploration of certain parts of Hispaniola in 1931, Dr. Alexander Wetmore collected a quart bag full of scrapings from under the edges of stones and such-like places on the small island of Beata. The casual collection has proved to be of unusual interest, for in it Paul Bartsch has discovered an amazing number of new land molluscs. The island itself is about 4½ miles long by 4 miles wide, and is formed of much-eroded limestone, densely covered in some places by scrub and cacti. The rubbish collected for shells was obtained along a quarter of a mile bordering the trail going inland from the north shore (*Proc. U.S. Nat. Mus.*, vol. 81, art. 6; 1932). Out of 16 species represented in the collection, the author describes 13 new species, 1 new sub-species, and 1 new sub-genus (*Chrondropomella*). The affinities

of the forms described and figured are distinctly Haitian, but all are so strikingly differentiated that it is safe to believe that Beata Island has for a long time been separated from the larger island. Yet it is only six miles off Beata Point, the southern extremity of Haiti, with which it is connected by a submarine bank at a depth of 12-18 feet below the surface.

Mosaic Disease of the Tomato.—Much confusion about the terms 'streak', 'stripe', and 'mosaic' in relation to tomato diseases must have existed in the minds of market growers. It has been suggested that *Bacillus lathyri* can cause stripe, and that this malady is accentuated by the absence of potash fertiliser in the soil. A short paper by Mr. G. C. Ainsworth in the seventeenth annual report of the Cheshunt Experimental and Research Station, 1931, makes clear the relationship of the three diseases. Mosaic is caused by a virus; streak by a mixture of mosaic and another potato virus. Inoculations from striped plants almost invariably gave mosaic symptoms, and it looks as though the virus has considerable causal connexion with stripe. Progress reports on "Physiological Investigations of Mosaic Disease" are also given in the same publication by Messrs. W. H. Read and B. D. Bolas.

Northern Land.—Some discoveries regarding the little-known Northern Land, or Severnaya Zemlya (formerly Nicholas Land), are given in the *Polar Record* for July. They are the result of the Soviet Union expedition that has been wintering at the observatory on the Serge Kamenev Islands to the west of Northern Land. Extensive sledge journeys prove that Northern Land consists really of three large islands and many small ones. Komsomoletz, the most northern, has an area of 3610 sq. miles and reaches to lat. 81° 16′ N. The narrow Red Army Strait separates it from October Revolution Island (5510 sq. miles), which in its turn is divided from Bolshevik Island (3420 sq. miles) by Schokalski Strait. The expedition worked chiefly on the two northern islands, both of which are mainly lofty and dome-shaped with receding ice-sheets that cover about eighty per cent of the area. These sheets are said to be the remains of a Quaternary sheet which enveloped all the islands and the Taimir Peninsula. Round the edges of the present ice-sheets several nunataks were noticed. Stagnant valley glaciers occur. Northern Land appears to be part of the same post-Permian foldings that are represented in the Taimir Peninsula. Its present outlines are due to a series of Quaternary faults. On the lower western sides there are still faults approximately in a meridional direction. There seems to be a general elevation of the land in progress. The expedition is continuing its work.

Recent Displacements of the Earth's Crust in Japan.—The repeated levellings carried over certain districts in Japan show that crustal movements have been taking place recently, some of them in connexion with great earthquakes, others in regions within which no earthquake has occurred for many years. Prof. C. Tsuboi contributes the fourth of his valuable memoirs on the deformation of the crust with and after the Tango earthquake of 1927 (*Earthq. Res. Inst. Bull.*, vol. 10, pp. 411-431; 1932). In this, he considers the displacements of 226 triangulation points of the third order, in addition to 6 of the first and 41 of the second orders. The complete map closely resembles one already reproduced in NATURE (vol. 126, p. 923), except that it covers a much larger area. Prof. Tsuboi also gives a number of maps representing the displacements in various ways. Of these, one of the most interesting is that showing the principal axes of the strain ellipses. These have very large values of ellipticity along two zones at right angles to one another and coinciding with the Gomura and Yamada faults produced at the time of the earthquake of 1927. The author concludes that the Gomura fault was due to a contracting movement and the Yamada fault to a shearing movement of the earth's crust. Another article communicated by the Institute (pp. 490-491) shows the changes of level along the south coast of the main island of Japan, the route surveyed in 1889–1900 and again in 1931 being 330 miles in length from Okitu to Kusimoto. The principal results are a depression of the west coast of Suruga Bay amounting to 7·5 in., to the west of the bay an elevation reaching 10·8 in. north of the Bay of Atumi, succeeded by depressions of 9·3 and 8·5 in. at the head of the Bay of Ise, which lies a short distance to the south of the central area of the great Mino-Owari earthquake of 1891.

Oil and Gas in Eastern Canada.—Four years have elapsed since the publication of G. S. Hume's account of oil and gas in the west of Canada, and there has just appeared, by the same author, a complementary report on eastern developments (Canada, Department of Mines, Econ. Geol. Series No. 9, 1932). The staying power of these eastern fields has been, and is, remarkable. One has only to refer back to F. G. Clapp's composite memoir on the petroleum and natural gas resources of Canada, published in 1915, to appreciate this. Seventy years ago the first well was drilled on Black Creek, the present site of Oil Springs Field, Lambton County, Ontario, and the discovery of the Petrolia Field followed soon afterwards; to-day, in spite of numerous other 'finds' in this region, these two fields still maintain their supremacy. It is gratifying to note that Ontario still encourages, by successful results, exploration for natural gas, for which product it has a long and enviable record. Stony Creek Field, near Moncton, New Brunswick, is the only oil and gas producing area east of Ontario, and its intensive geological study is being undertaken to provide new light on possibilities in other parts of this province and Nova Scotia.

Relative Abundance of Oxygen and Nitrogen Isotopes.—The discovery of rare isotopes of oxygen and nitrogen from band-spectra has been followed by several investigations of their abundance, with discordant results. In the second July number of the *Physical Review* a careful study of this question is reported by G. M. Murphy and H. C. Urey, on the basis of the absorption spectrum of nitric oxide obtained from a variety of sources. The method consisted essentially in a comparison of the concentrations of the two molecules $N^{15}O^{16}$ and $N^{14}O^{18}$, each of which contains one rare isotope and one common, and leads to a ratio of 350 : 1 for N^{14}/N^{15}. This is in good accord with chemical and mass-spectrograph data, but less than the best results obtained from emission spectra. The apparently erratic contributions of isotopes to the light emitted from a substance still remains an unsolved problem. In the present work, no difference was found in the isotopic composition of the nitrogen and oxygen from the different sources, of varying geological age.

Combustion of Hydrocarbons.—Prof. W. A. Bone's Bakerian Lecture (*Proc. Roy. Soc.*, August) was devoted mainly to a review of experiments on combustion of hydrocarbons, mostly already published, which bear on the nature of the compound formed initially between the hydrocarbon and oxygen. The problem has been to decide if this contains a hydroxyl group, or is some form of peroxide. Prof. Bone inclines strongly to the former view, which is supported by a great weight of qualitative and quantitative evidence,

particularly in the case of the slow combustion of ethane, where 36 per cent of ethyl alcohol has been isolated without a trace of peroxide. In cases where quantities of peroxide, usually small, have apparently been obtained amongst the products of reaction, Prof. Bone considers their identification not conclusive, and the evidence insufficient to prove that they were formed initially and not as further products from intermediate aldehydes. Prof. Bone does not however consider that 'peroxidation' may not occur in rather abnormal circumstances, saying in his summary that "In any case, even if eventually proved valid in particular cases or circumstances, 'peroxidation' can scarcely be regarded as being more than supplementary to 'hydroxylation', nor 'peroxide' as more than a side-product. In other words, it might possibly afford an explanation of 'knock' as an abnormal feature of hydrocarbon-air explosions, but scarcely of the normal course of oxidation therein." In another investigation, reported in the same issue of the *Proceedings*, C. Campbell, W. B. Littler, and C. Whitworth have succeeded in making an estimate of the pressure in explosion waves from the failure under impulsive shearing, induced by the waves, of copper foils the strength of which had been determined statically.

Calcium Equilibrium in Sea Water.—A drift of calcium away from cold polar waters and a concentration of calcium carbonate in the warm shoals of the tropics seems to be a feature of to-day. There is a probable undersaturation of sea water under some conditions and saturation to precipitation point under others. Bacteria are present in the deposits, and something is known of the physiological changes which these organisms can produce in the water. But what changes will produce a precipitate have never been established. The oceanographical aspects of this problem have long been the concern of Wayland Vaughan, who has initiated a full investigation at La Jolla under Haldane Gee, six papers of which are now published in the June *Bulletin of the Scripps Institute* under the title "Calcium Equilibrium in Sea Water". The theoretical considerations are summarised, and it is shown that tropical, shoal sea water should be approximately in equilibrium with solid calcium carbonate. At La Jolla the water may be slightly more than saturated with calcium when its temperature is raised to 27° C. Experimentally it is shown that calcium carbonate can be precipitated from raw sea water by reducing the total carbon dioxide content at a temperature of 28°-30° C., and ammonia tends to reduce its solubility for calcium. As experiments require long periods before approaching a stable state, rigorous conditions could only be established by eliminating all possible biological activity in the water, and this led to Gee's invention of a special apparatus, using Berkefeld filters, which is herein described. This proved successful, and calcium carbonate was precipitated aseptically from sea water under tropical conditions by reducing the total carbon dioxide content of the water. The precipitate was found to consist of needles of aragonite, practically identical in form, size, and optical properties with crystals of natural argonite from the calcareous bottom muds of the Bahamas.

Astronomical Topics

Faye's Comet.—A telegram from the I.A.U. Bureau, Copenhagen, announced the detection of this comet at Bergedorf. B.Z. No. 33 announces that the plate showing it was exposed for 2½ hours by Dr. Wachmann, Dr. Guyot, and Dr. A. Schwassmann. The position on Aug. $30^d\ 0^h\ 37^m\ 12^s$ U.T. was: R.A. (1932·0) $0^h\ 27^m\ 1{\cdot}79^s$, N. Decl. 14° 53′ 32·5″, mag. 12·0. The perihelion passage will be about Dec. 5·68. The ephemeris in the B.A.A. Handbook may be used with the following corrections; Sept. $9 + 1^m\ 20^s + 4'$, Oct. $11 + 1^m\ 36^s + 6'$, Nov. $12 + 1^m\ 27^s + 4'$. As the comet is approaching the earth until Oct. 22, when its distance is 0·71 units, it is likely to brighten considerably. This is the eleventh observed apparition of the comet. It has only been missed at two returns, in 1903 and 1917.

Eleven comets have now been detected in 1932, but one of them (Carrasco) had perihelion in 1931, and two others (van Biesbroeck and Schmitt) were not observed sufficiently to receive permanent numbers.

The Reinmuth Planet, 1932 HA.—The following observations of this body, made by photography at the Union Observatory, Johannesburg, have come to hand; they are the only observations yet available from the southern hemisphere:

	R.A. (1932·0).	S. Decl.
1932 May 7·75017 U.T.	$12^h\ 6^m\ 22{\cdot}88^s$	10° 52′ 20·2″
7·76679	12 6 6·02	10 52 16·8

These, when compared with northern observations, indicate a parallactic displacement of more than 100″; this enables us to obtain a fairly exact estimate of the planet's distance from the earth, and hence of its period. This appears to be longer than the early determinations, and in the neighbourhood of 1·83 years, so that Eros, with its period of 1·76 years, is still the minor planet with the shortest period. If 1·83 years is correct, there will be a recurrence of configurations after 11 years, being 6 revolutions of the planet. There would in this case be a fairly close approach to the earth at the ascending node in the autumn of 1941, and one at the descending node in the spring of 1943. It will be difficult, but perhaps not impossible, to observe it earlier, as its distance from the earth will be considerable.

Forms of Spiral Nebulæ.—The spiral forms of the great nebulæ have engaged the attention of many mathematicians, but hitherto no completely satisfactory explanation has been reached. A recent paper by Mr. B. M. Peek (*Mon. Not. R.A.S.*, May) tries to explain them in terms of some simple assumptions. It is assumed that the nebula is rotating and contracting, so that the angular velocity increases, and at length matter begins to be shed at the rim, when the acceleration balances gravity. It is further assumed that the shedding begins at two opposite points, which are the points where the outward tidal action of external nebulæ is greatest. Once ejection has begun, it is shown that the tidal action of the ejected matter far exceeds external tidal action, and constrains the outer rim to move with the ejected matter.

Different laws for the rate of contraction of the nebula are tried; all give spiral forms for the outer matter, but the best approximation to observed nebulæ is found to be that the contraction varies as the cube of the radius. An extremely good approximation to the form of the nebula Messier 81 is worked out on this assumption. A point which causes Mr. Peek to have some doubt about his results is the shortness of the time-scale. He finds that the times required to reach about three convolutions are of the order of two hundred million years. A few years ago a time-scale of millions of millions of years was generally accepted; but considerations based on the expanding universe have diminished this a thousandfold. Mr. Peek gives one or two hints that may help to span the remainder of the gap. The spirals found by Mr. Peek are not equiangular; in most of them the inner whorls are more circular than the outer ones.

Greenland Hydroids

DR. P. L. KRAMP in two recent papers * discusses the hydroids of Greenland. The area investigated in the first is extensive, comprising the entire west coast of Greenland from Cape Farewell to Etah in the narrowest part of Smith Sound, and several series of stations laid from the Greenland coast across the Davis Strait and Baffin Bay as far west as possible; in several places the investigations being carried through to the coasts of Labrador.

The second paper deals with the hydroid fauna of representative fjords belonging to two groups, the so-called 'Atlantic' and 'Arctic' types. The difference between these two types is that in one the entrance is deep enough to allow the comparatively warm water of Atlantic origin in the deeper parts of the Davis Strait to come into the fjord, in which the bottom water, therefore, has a fairly high temperature. In the other, a threshold at the entrance prevents (or prevents for most of the year) the Atlantic water from entering the fjord, in which the bottom water is therefore very cold. North Strömfjord, investigated by Dr. V. Nordmann in 1911, was selected as the representative of the arctic type; and in the summer of 1912, Dr. K. Stephensen investigated Kvanefjord near Frederikshaab, Bredefjord, north of Julianehaab, and Skovfjord, six miles farther south, as representative of the Atlantic type.

It is an interesting fact that each zoogeographical group of species of hydroids has in all essentials the same bathymetrical distribution in both types of fjord, which agrees with the ascidian fauna as found by Hartmeyer. Stephensen found, however, that the crustaceans, pycnogonids, and echinoderms in North Strömfjord consist entirely of arctic and arctic-boreal species, whereas several boreal and Atlantic forms occur in the southern fjords. The only exception in the hydroids is that the abyssal Atlantic species are wanting in the North Strömfjord; otherwise in both types there are arctic, arctic-boreal, boreal, and cosmopolitan species in almost the same proportions at similar depths.

Species of all the zoogeographical groups, even boreal forms, were found at considerable depths and at low temperatures in North Strömfjord, but Dr. Kramp is of the opinion that the late summer and autumn temperatures in deep water rise to fairly high values. Stephensen and Hartmeyer emphasise the constantly negative temperature of the water at all depths from about 60 m. downwards, but Dr. Kramp observes that some hydroids are able to live for a long time under very unfavourable conditions of temperature if there is a short period when conditions are favourable. If the temperature rose sometimes to one or two degrees above zero, the presence of these boreal species would be quite explicable. On July 31, 1911, the bottom temperature at one of the stations near the entrance to the fjord at a depth of 170-200 m. was 1°-2°, and later in the year, according to Dr. Kramp, it will probably be higher, and this comparatively warm water will enter the fjord and mix with the other water layers, causing a rise in temperature for a time. As he suggests, the positive temperatures sometimes noted from these depths in Dr. Nordmann's journal, and considered erroneous, may not be altogether wrong, and there is no doubt that the violent currents cause a fair amount of mixing of the water layers. Thus the author explains the presence of some boreal species of both hydroids and ascidians which are able to propagate and grow at intermediate depths in North Strömfjord as due to the combined action of the influx of Atlantic water from the outside and of the vertical movements which bring down the surface water, heated during the summer, resulting in an increase of temperature in the deeper strata at certain periods of the year.

Dr. Kramp has also recently published "A Revision of the Medusæ belonging to the Family *Mitrocomidæ*". † As medusæ are of considerable use as indicators of sea-currents, it is important to be certain of the species with which we are dealing, and the memoir is very helpful in enabling us to distinguish the members of this family, at the first glance so similar to one another.

* Kramp, P. L. The Godthaab Expedition 1928. Hydroids. *Medd. om Grønland. Komm. for Vidensk. Undersøg. i Grønland.* Bd. 79, Nr. 1, 1932. Hydroids collected in West Greenland Fjords in 1911 and 1912, *ibid.*, Bd. 91, Nr. 3, 1932. (København: C.A. Reitzels Forlag.)

† Reprinted from Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening, vol. 92. Pp. 303-387. (København: Bianco Lunds Bogtrykkeri A.S., 1932.)

Megalithic Monuments of Brittany

IT was to be expected that megalithic monuments, and in particular circles, stone or other, would occupy much of the attention of the International Congress of Prehistoric and Protohistoric Sciences, recently held in London, especially as arrangements had been made to give many of the overseas members their first opportunity to view the site of the wooden circles at Woodhenge and 'The Sanctuary'. In fact, two whole sessions of Section III.A of the Congress were devoted to the subject. Among the communications then presented, special interest is attached to that of the veteran field archæologist, M. Z. Le Rouzic, whose prolonged and practical acquaintance with the problem of the megalith in Brittany gives him unquestioned authority on the subject chosen for his communication: "Morphologie et chronologie des monuments sépulchraux de Morbihan".

M. Le Rouzic classifies the megalithic monuments into ten groups as follows:

(1) Dolmens with rather irregular chambers and corbelling and an entrance passage roofed with small blocks; the whole is buried in a tumulus with a limiting circle of upright stones. Associated are polished axes, some small and votive, fine flint arrowheads with barbs and stem, flint scrapers, borers, etc. The pottery is both fine and coarse; with these are pot spindle whorls and stone beads. An example is Parc Guren (Crac'h).

(2) Dolmens with long entrance passage and side chambers, built of large blocks. Also '*allées couvertes*' with port-holed supports. Corbelling is usually above large block-uprights. The monument is embedded in a cairn and often surmounted by a menhir. Uprights are often engraved. Associated are bell-beakers, 'bowls-with-support', beads of callais, etc., ornaments of hammered gold, as well as objects of Group 1. There are a few foreign types of fine flint work and copper or bronze daggers. Both burials and cremations are found—Kercado, Mané Lud, are good examples; also some '*allées couvertes*' of elbowed form (Le Pocher, Plougoumelen). Kerlescant '*allée couverte*' formerly had a port-hole. Île Longue is the finest corbelled tomb in Brittany.

(3) Tumulus with quadrangular cist, or cists of blocks or dry walling with hearths inside them. Purely neolithic associations. The second tumulus of

Le Manio contains 39 cists. There is a decorated menhir above it.

(4) Dolmens in a tumulus with contemporary cists. This is probably a combination of Nos. 1 or 2 with No. 3. No. 2 is probably an intrusive culture, No. 1 an impoverished local form of No. 2, and No. 3 either another local form based on No. 2 or an intrusive type of some other origin.

(5) Monuments containing a closed dolmenic chamber, often built with dry walling. (*a*) Yield fine jadeite, etc., axes, some very small and provided with suspension holes, ring-discs, many callais beads, but very little pottery; for example, Mt. St. Michel (Carnac) and Ker Lud. (*b*) Yield no callais but have arrowheads of translucent flint, copper or bronze daggers, halberds, and flat axes. The chamber is somewhat sunk; originally it had wood-covered walls. None of these monuments are found in the sacred Carnac region. They are probably the work of invaders or strangers. Examples are Mané-er-Loh, Mané Roullarde, Mané Kervilor.

(6) Tumulus enclosing a closed dolmenic chamber and stone cists (compare No. 4, but in this case a hybrid of 3 and 5), handled pots. The dating is early bronze age; examples are St. Germain, Erdeven.

(7) Tumulus with rectangular dry-walled cists. Associated are lances and blades of bronze. These are probably the poor successors of 5*b* and 3 crossed. Mané Rumentier is an example.

(8) Tumulus with six-slabbed cists. With these are bronze pins and black pottery. The dating is iron age; example, Mané Bekernoz.

(9) Tumulus with rectangular fossa in a circular enclosure with four-handled pots, objects in bronze and iron, and beads of blue glass. No. 7 at Le Rocher (Plougoumelen), Hallstatt and La Tène periods.

(10) True La Tène burials in subterranean chambers are found only in La Tène III.; for example, Kerfraral. To the same period belong tumuli with small entrance passages. They are often filled with black earth and charcoal and contain a hearth. Examples are Mané Roullarde, Mané Bras de Kervilor. No. 10 indicates the persistence of the influence of Nos. 1 and 2.

A second communication dealing with megalithic monuments in Brittany was presented by Prof. C. Daryll Forde on "The Typology of Megalithic Monuments in Brittany". Prof. Forde pointed out that Brittany contains a very complete range of megalithic and associated tombs from corbelled and rock-hewn chambers to small cists and coffers. The passage chamber is the basic form, and it is probably both relatively and absolutely most abundant in south Morbihan. It is usually truly megalithic. The Breton tombs show close parallels with the southern Iberian. The development of a multiple passage tomb in south Morbihan may have been the starting point for the rough grouped chambers found outside that region, and may have been the model for some of the tombs in the English long barrows.

Angled galleries and large closed chambers are specific Breton types, rare outside the peninsula, and mostly confined to the south. The covered gallery ('*allée couverte*'), in form, distribution, and some characteristic grave-goods, indicates connexions with north-east France; but its contemporaneity with other tombs is shown by the presence of the bell-beaker. A number of auxiliary grave types are associated with the larger tombs: small coffers of heaped stone fragments, stone cists, and trench graves. These are sometimes found under the same tumuli as megaliths without suggesting secondary interment.

The material from tombs of different type does not show much variation. While certain objects have a restricted geographical range, they are not confined to a single type of tomb. The concentration, fine construction, and abundance of Iberian parallels in southern Morbihan indicate that this was the first centre of megalithic construction in Brittany. The culture stagnated after the first diffusion, while the Armorican graves of the late bronze age show a very complete break with the tradition of the megalith builders.

British Phenology

THE Phenological Report, 1931, issued as a special number of vol. 58 of the *Quarterly Journal of the Royal Meteorological Society*, is the forty-first report of this kind. It deals primarily with variations in different parts of the country in the dates of the first appearance of certain birds and insects, of the first singing of various species of bird, and of the date of commencement of flowering under natural conditions of various plants of the country-side; it is consequently mainly in the form of statistical tables. Observers increased from 500 in 1930 to just over 600 for this issue, mainly as a result of broadcasting; while the south is well supplied with observers, there is still opportunity for more in the more remote areas, especially Wales, Scotland, and Ireland.

This particular number does not differ much in form from those for other recent years, although it contains a new feature in the form of a map showing what are described as average spring migrant isophenes—a system of lines of equal average date of arrival of twenty species of migratory bird based on records obtained during the seventeen years 1914–30. The dates are in the notation generally adopted in phenological work, that is, they are expressed as the serial number of the day in question, Jan. 1 being taken as 1, Feb. 1 as 32, and so on. Such a map of normal dates of arrival can be used when it is desired to know to what extent a particular year is abnormal in regard to the average time of arrival of migrants, and also may give information about the nature of bird migration to anyone capable of interpreting the figures; for example, the existence of closed areas of relatively late arrival superimposed upon a general retardation from south to north (the latter exceeding a fortnight as between southern England and northern Scotland), often corresponding roughly with elevation of the land, suggests a secondary feature of the migrational movement connected no doubt with the well-known backwardness of plant and insect development in higher and therefore colder localities, complicated by other factors if the lines are to be trusted.

A weather summary based on the published records of the Meteorological Office is included to enable the student to trace the effects of the weather upon the phenological records, and a table which appears for the first time in the present Report is Table I.D, showing the number of *weeks* with 'decided' and 'excessive' divergences of the three main weather elements, based on unpublished weekly weather returns. Table VI. includes *decade* means of the thirteen plants used in the records for comparison. The unique series of observations of trees and shrubs taken at St. Michael's, Tenbury, Worcestershire, in Table VII., and those of plants and birds taken at Hevingham, Norfolk, in Table XIV., are making their last appearance owing to death and infirmity.

The year 1931 was particularly interesting on account of the severe frosts in March and October, and much dull weather in the late summer.

Scientific Aid in Agriculture

THE story of the founding at Indore, in Central India, of an Institute of Plant Industry, its unique territorial associations and duties, the work in hand, and its bold, comprehensive policy of research has become widely known through the writings of its first director, Mr. Albert Howard. These have now been extended by articles in the *Empire Cotton Growing Review*, vol. 9, Nos. 2 and 3, 1932, entitled "The Improvement of Cotton Production". Plans are explained for dealing with specific cotton problems in Central India, but the articles also contain an important treatment of the general question of policy in agricultural research. During the past twelve months enforced economies have made responsible bodies all over the world scrutinise closely their disbursements on agricultural research. Some have inclined to grasp an excuse for ending scientific work with which they never sympathised, but the more common and the reasonable reaction has been to ask whether all the work in progress is well conceived and likely to benefit industry. Howard, speaking of the present position—a superabundance of raw cotton and low prices—asks if science can help the cotton industry under such conditions, and he bluntly adds that if it cannot "the days of agricultural research are indeed numbered".

Against agricultural research in general is laid the charge that practical problems have always been approached by one science at a time, working alone. This has imposed on research stations an inelastic organisation which, weakly following the strict departmentalism required for the teaching of the sciences, has produced rigid specialists and set them to attack isolated fragments, leaving major problems untouched, It is suggested that research must concern itself less with the details of existing agricultural methods and more with the possibility of evolving wholly new methods to meet the changes of situation which have swept over all branches of crop production. If cotton growing is to be substantially aided, the living plant must be the centre of action, and this can only be studied effectively in relation to the soil, the agricultural conditions, and the economic uses. Study of this kind, however, is not provided for by the accepted subdivisions of agricultural science. A new, broader outlook on agricultural problems is needed, with consequential changes in research organisation.

When he deals with "the improvements which really matter", Howard prescribes for cotton-growing improvement "a well-balanced combination of agronomy and genetics with soil science". Against insects and fungi the cultivation of suitable varieties in an efficient manner is urged as the only practicable method, and support is derived for this view from the history of the now famous sugar researches in Java.

Some of the minor points may be considered contentious and open to criticism, but the main thesis is an important statement on a great and urgent problem. To ask for attack on a wide front, for joint action by the various formal divisions of science, and that the structure of the industry itself should be added to the subjects for investigation, is to ask for no more than systematic planning of research, based upon careful reconnaissance of industry. Whether crop production can better be helped by inviting specialised branches of science to choose their own problems or by trying to resolve great practical problems into their scientific components and applying the sciences to these is the essential question these articles try to answer. F. L. E.

Annual Exhibition of the Royal Photographic Society

THE seventy-seventh annual exhibition of the Royal Photographic Society was opened on Sept. 9 at the Society's house at 35 Russell Square, London, W.C. The exhibition will remain open each weekday until Oct. 8.

The Scientific and Technical Section this year, besides its usual features, possesses a notable series of photographs of the invisible. On one hand are some excellent examples of fluorescence photography of visually undecipherable documents. Here the invisible writing is shown by differential fluorescence of the parchment or paper surface when exposed to ultra-violet radiation. At the other end of the scale, photography by means of plates sensitive to the infra-red is shown in several aspects. First are many examples of long-distance photography through haze. Next are shown photographs taken in complete darkness, among them being photographs of hot flat-irons taken by their own invisible radiation. A very interesting example of the application of infra-red photography has been made in the examination of some rare old books in which certain passages were deleted some three hundred years ago by the censor for the Spanish Inquisition. The ink used for the deletions is, however, transparent to infra-red radiation, though the original printed characters are opaque; infra-red photography has thus been able to make the original paragraphs easily legible. Infra-red photomicrography has been mentioned recently in these columns; some fine examples of this work are shown in the exhibition. Lastly, spectrograms are shown taken with plates sensitised with xenocyanine; by using this sensitiser many new lines have been recorded in the spectra of the rare gases between 8500 and 11,000 A.

Chemical engineers will be interested to find on view a working model of an electrolytic plant for the recovery of silver from used fixing baths. The exhibit represents part of a motion picture film laboratory in which millions of feet of film annually are developed, fixed, washed, and dried. In one of these factories the cost of the hypo fixing baths may easily exceed £2000 a year, and the unreduced silver bromide which is dissolved from the film may represent as much as £7000 worth of metallic silver, even at its present low price. Previously, the silver was salvaged by throwing it down as a sludge of silver sulphide, which had then to be treated by a somewhat costly refining process. The silver is obtained by the new process as 98 per cent pure metal on stainless steel cathodes. Fortunately, owing to an admixture of a small amount of gelatin, the deposit is very brittle, so that it can be readily scaled off from the cathodes. The hypo itself is regenerated by the electrolysis, and is run back into the fixing tanks for further service; owing to dilution and to the accumulation of soluble bromide, however, the solution would eventually become unfit for use; for this reason, about one-third of the desilvered solution is run to waste, and fresh hypo is added to the fixing baths. The total consumption of hypo is thus reduced to about one-third of the amount employed formerly.

In its other sections the exhibition maintains its customary high standard. The Colour Section, while not being large, contains some very fine examples of three-colour portraits. The examples of Press photography bear ample witness to the very high sensitivity obtained in certain new panchromatic materials.

University and Educational Intelligence

CAMBRIDGE.—Dr. Walter Langdon Brown has been appointed regius professor of physic in succession to Sir Humphry Rolleston, who retires on Sept. 30 on completion of his term of office.

Mr. J. O. Giršavičius, of Gonville and Caius College, has been elected to the Benn W. Levy research studentship in biochemistry.

LEEDS.—A series of sessional courses for teachers has been arranged to be held on Saturday mornings. The biology course will be divided into classes on the biology of the tree by Prof. J. H. Priestley and on the fundamental biology of animals by Mrs. A. Redman King. Mr. J. C. Gregory will give a course of lectures on elementary science, and Mr. W. P. Welpton on the teaching of mathematics. Although these courses are intended for teachers, particularly those in Senior Schools, other students may enter. Further information can be obtained from the Registrar.

A COURSE of lectures on television has been arranged to be given by Mr. J. J. Denton, secretary of the Television Society, in the Electrical Engineering Department of the Borough Polytechnic, Borough Road, London, S.E.1. The lectures will be given on Thursdays, commencing on Oct. 6. Further information can be obtained from the Principal.

A VACANCY exists for an assistant master at the Prince of Wales' Royal Indian Military College, Dehra Dun, United Provinces, India. The College was established in 1921 for the education of Indian boys in preparation for entry into Sandhurst and other military colleges and eventually for a military career as officers. The number of pupils at present in the College is 115. The normal age of entry is 11-13 years, and the course extends over six years. The assistant master appointed will be expected to teach science, especially physics. The starting salary varies from 550 to about 800 rupees a month according to age, and rises to 1500 rupees plus £30 a month (1 rupee = 1*s*. 9*d*.). These rates are, however, being subjected to a temporary reduction, not exceeding ten per cent, owing to the present state of financial stringency. Free quarters are provided, and the master appointed will receive an outfit allowance of £50 and free first-class passage to India. One of the assistant masters at the College is at present on leave in Great Britain and would be pleased to meet any intending candidates. Further information can be obtained from the Secretary, Military Department, India Office, London, S.W.1.

A "HISTORY of the Municipal University in the United States" has been published as a bulletin (No. 2 of 1932) of the Office of Education, Washington. The author, who is professor of the history of education in the Ohio State University, describes the origin and development of all those universities, eleven in number, which are directly under the control of municipal authorities. Universities which are municipal in this complete sense appear to be peculiar to the United States, where they represent an attempt to do for the citizens of the city what the State university does for the citizens of the State. Their emergence is regarded by the author as part and parcel of a great movement of increasing participation of public authorities in the provision and control of modern education, and as being an extension upward of the public school system of the city. Many of the newer universities in England and Germany, although not directly under the control of municipalities, are, like the American municipal universities, closely linked with them by mutual services, and owe their origin partly to a desire to provide educational opportunities for persons who would be unable to seek them elsewhere. In these and other institutions for advanced instruction and research where the work is closely related to local needs this historical survey will be read with interest.

Calendar of Geographical Exploration

Sept. 20, 1519.—First Circumnavigation of the Globe

Ferdinand Magellan sailed from San Lucar with a fleet of five ships under instructions to sail south by the coast of Brazil and thence to penetrate to the Moluccas. During their five months' stay at Port St. Julian, lat. 49° 20′ S., the Spaniards came into contact with Patagonian tribes and were struck by their tall stature. Sailing south, Cape Virgins was reached and the great discovery made; the passage through the strait was difficult and occupied 38 days, one ship deserting during the exploration. The trade winds carried the three vessels which passed the strait far from the Pacific islands, and in their nearly four months on the open sea the men suffered from hunger, thirst, and disease; nineteen died. Puka Puka in the Paumotu Archipelago was sighted on Jan. 24, 1521. Magellan was killed by natives on the island of Mactan on April 27, 1521. He had proved that the world was round, and had opened the way for the circumnavigation of the globe which was completed by Sebastian del Cano in the *Vittoria*, which reached San Lucar on Sept. 6, 1522, the only vessel of the five to return. Magellan left no record of his journey, and it was long before his remarkable feat of seamanship and endurance was recognised as one of the greatest events of exploration. He achieved the linking of western Europe with eastern Asia as a result of deliberate planning and first-class seamanship. By origin he was a Portuguese nobleman and his first voyages were undertaken for Portugal, but when he fell into disfavour with King Manuel he adopted Spanish nationality, and it was in the service of Charles V. of Spain that he made the voyage on which his fame rests.

Sept. 20, 1893.—Drift of the *Fram*

The *Fram* was frozen into the ice off the New Siberian Islands in 77° 30′ N., and drifted with the ice, on the whole in a north-westerly direction, reaching 85° 55′ N. in 66° 31′ E., the highest latitude ever reached by a ship. Nansen had convinced himself that there was a polar drift, and having planned the *Fram* to resist crushing in such a way that, if nipped in the ice, the opposing masses would pass under her and lift her to the surface, he deliberately committed her to the ice and awaited the results. The originality of the plan was only equalled by its daring: the party numbered 13 in all. After the second winter on the ice, when the northward movement seemed to be checked, Nansen and Lieut. H. Johansen left the ship in order to explore the regions towards the pole by travelling on ski, with dog sledges carrying kayaks. They could not hope to reach the drifting *Fram* again, but trusted to reaching Spitsbergen and there finding a tourist steamer. The intrepid explorer met with the success his plan deserved. Nansen and Johansen reached 86° 5′ N., the nearest to the pole that had ever then been attained. They travelled south with much difficulty, encountering many dangers, including attacks by wild beasts. They wintered on Jackson Island in a stone hut which they built and roofed with their silk tent. They lived like the Eskimo on bear and walrus meat, cooked over a blubber lamp. Travelling

south in 1896, they met F. G. Jackson, in whose relief ship they returned to Norway, arriving at Vardö on Aug. 13, 1896, full of anxiety as to the fate of the *Fram*. On that very day the *Fram* broke out of the ice, the whole party meeting in Tromsö the following week. On this unique and daring journey no life was lost, the ship was undamaged, and a rich harvest of scientific data was secured.

Sept. 22, 1631.—Foxe Channel

Luke Foxe reached his highest latitude, 66° 47′, after following the coast of Foxe Land and passing through Foxe Channel. He had left England in May 1631 in search of the north-west passage, feeling confident that he would return with a cargo of pepper from the East Indies. He did not succeed in this, but he rendered great service to geography by completing a rough survey of Hudson Bay, and by discovering and penetrating far into Foxe Channel. He also drew a map, now famous, showing with considerable accuracy the arctic regions as then known.

Societies and Academies

London

Institute of Metals (Annual Autumn Meeting), Sept. 12–13.—**H. J. Gough**: Corrosion fatigue of metals (Autumn Lecture). Corrosion fatigue of metals is defined as the behaviour of metals subjected to cyclical stresses while exposed to an environment of an oxidising nature. Following a brief historical account, the nature of the general problem, the nomenclature employed, and the characteristics of laboratory tests are stated; representative failures in service are described. Consideration is then given to the general influences of chemical composition, heat treatment, and cold working on the resistance of metals to corrosion fatigue, also of the effect of time, number of cycles, and corrosivity of environment as factors in the process. Primary importance is attached to the behaviour of protective films under the straining actions associated with cyclical stressing.—**W. R. Barclay, G. A. V. Russell, and H. Williamson**: Modern works plant and equipment for the hot-working of nickel and nickel alloys. This paper describes a modern plant erected in Great Britain as a result of experience in the hot-working of nickel and its alloys, and a close study of the conditions under which similar work is carried out on the Continent and in America. The main features of the plant are: (1) hydraulic forging press; (2) hot rolling mill. The heating of sheet-bar for rolling into sheets is carried out in a specially designed electric resistance furnace.—**G. L. Bailey**: Mould materials for non-ferrous strip ingot casting. Grey cast iron is the material most generally used for moulds for the casting of non-ferrous strip ingots. Cast-iron moulds are subject to two particular defects, gas evolution from the face of the mould when this is overheated during pouring ('blowing'), and transverse cracking of the working faces. Copper is considered the most satisfactory material for strip ingot moulds. Its high thermal conductivity prevents serious temperature gradients and consequent distortion.—**E. J. Daniels**: Some reactions occurring in 'hot-dipping' processes. The part played by fluxes has been investigated and a general agreement found with diverse processes. The contamination of the liquid metal is an inevitable factor in hot-dipping, soldering, etc., and methods for controlling it are indicated.—**N. P. Allen**: The effect of pressure on the liberation of gases from metals, with special reference to silver and oxygen. The liberation of oxygen from silver during solidification has been studied by means of cooling curves. The gas is evolved when the 'internal pressure' of the dissolved gas becomes greater than the hydrostatic pressure of the liquid metal, and by applying a sufficiently large pressure to the liquid metal the formation of blow-holes can be prevented. The equilibrium of the silver-oxygen system is discussed and the existence of a eutectic shown.—**J. D. Grogan and T. H. Schofield**: On the removal of gases from aluminium alloys by mixtures of nitrogen and volatile chlorides. Raw cylinder nitrogen may be employed. The quantity of chloride needed is small. Metal treated in this way possesses excellent mechanical properties.—**H. A. Sloman**: Researches on beryllium. With the progressive elimination of metallic impurities, the brittle nature of the early metal was not greatly altered. This brittleness was afterwards found to be due to a beryllium/beryllium oxide eutectic surrounding the metal grains. Most of the work has been directed towards the elimination of this oxide. Of all the methods attempted and described here, sublimation *in vacuo* has been the most effective.—**R. J. M. Payne and J. L. Haughton**: Some attempts at making beryllium-magnesium alloys. A description is given of various methods which were tried for the production of beryllium-magnesium alloys, all of which were unsuccessful.—**D. Stockdale**: The constitution of the lead-tin alloys. The micrographic method, two thermal methods, and a modified electrical conductivity method have been used in the determination of the solubility of tin in lead, which is shown to be 19·5 per cent by weight, at the temperature of the eutectic. This value is considerably higher than any other previously obtained.—**M. Cook and H. J. Miller**: The effect of different elements on the annealing and grain-growth characteristics of alpha brass. An examination has been made of the effect of additions of iron, phosphorus, manganese, and aluminium separately, and of aluminium with nickel, and aluminium with silicon, on the annealing characteristics of alpha brass by determining diamond pyramid hardness values and making grain-size measurements on cold-rolled alloys annealed at various temperatures, while the tensile properties on a number of alloys representative of the various series investigated have also been studied.—**J. H. Watson**: Liquation or 'inverse segregation' in the silver-copper alloys. The first formed primaries, whether of silver or of copper, are free to move under the influence of gravity, when the alloy is maintained for sufficient time at temperatures between the liquidus and the solidus. The primaries which have segregated under the influence of gravity are repelled from their position by the application of severe local chilling to their vicinity.

(*To be continued.*)

Paris

Academy of Sciences, Aug. 1 (vol. 195, pp. 345-404).—**J. Costantin**: High-altitude heredity acquired by the sugar cane. Historical account of the relations between the resistance of sugar canes to disease and the altitude at which they are grown, and the results of transplanting from high to lower altitudes.—**Paul Janet**: The International Congress of Electricity of 1932.—**P. Pascal and Mlle. J. Hansot**: The quantitative study of the adsorption of metallic cations by cellulose. Results with lead nitrate, thallium nitrate, and lead chloride are given graphically.—**Lucien Daniel**: A curious graft of the chestnut and pear trees. An account of a pear tree on which a chestnut has been accidentally grafted. Each bears its proper fruit and

foliage, and both are fed by a single trunk.—**E. Bataillon** and **Tchou Su**: The comparative study of the initial kinetic process in the impregnated egg of *Hyla* at various stages of growth.—**Vladimir Bernstein**: The directions of Julia and of Borel of integral functions of finite order.—**A. Lafay**: The prediction of the action of a rapidly changing wind. Application to the Katzmayr effect and to autorotation.—**R. de Fleury, H. Portier**, and **S. Benmakrouha**: Rules of transpositions with homogeneous factors of safety of equilibrium and stability at critical deformations.—**G. Rougier**: The variations of atmospheric absorption.—**J. Cayrel**: The permeability of a vacuum and the theorems of Chipart.—**Armand Bogros** and **Félix Esclangon**: The excitation of atomic jets by an electromagnetic discharge of high frequency. The method described promises to be of service in the study of the hyperfine structure of spectral lines.—**G. Bruhat** and **P. Chatelain**: The realisation of a photoelectric polarimeter.—**P. Soleillet**: The fluorescence of a jet of zinc atoms.—**F. C. Chalklin** and **L. P. Chalklin**: The partial absorption in the region of the soft X-rays.—**Mlle. J. Pernet**: The magnetic rotatory power of cerous chloride in aqueous solution. The thermal variation.—**P. Fourmarier**: The response of a gas-filled photoelectric cell to a sudden illumination. Study of the causes of lag in photoelectric cells: the results are given in three curves.—**Lemarchands** and **Jacob**: Remarks on chemical inertia. Starting with the hypothesis that the reaction temperature between a metal and chlorine should be proportional to the product of the boiling points of the metal and the chloride formed, experimental results are given for the reaction temperatures of a number of metals with chlorine. The concordance between the measurements and the calculated temperatures is satisfactory.—**Desmaroux** and **Mathieu**: The influence of temperature on the structure of nitrocellulose films. A discussion of the causes of the differences between the authors' results and those of J. J. Trillat. The concentration of the solutions and the temperatures at which the film is dried affect the crystalline form.—**Berthon**: Selective adsorption by silica gel in ammoniacal solutions of the heavy metals. In ammoniacal copper solutions the complex ion $(Cu(NH_3)_2)$ is adsorbed. Ammoniacal zinc sulphate solutions behave similarly.—**Georges Delbart** and **Edgar Lecœuvre**: Contribution to the study of low carbon cast-irons.—**Rambaud**: A particular case of allyl isomerism.—**A. Mailhe** and **M. Renaudie**: The formation of various organic sulphur compounds starting with ethylene hydrocarbons. The hydrocarbons (ethylene, propylene, butylene, and amylene) mixed with hydrogen sulphide were passed over silica gel at 700° C. A complex liquid mixture was obtained containing alkyl sulphides, thiophene and its homologues, and other sulphur compounds.—**Romer**: The present condition of Mt. Pelée. The eruption of 1929-1932 resembled that of 1902 but was on a smaller scale. Some of the protective topographical features have disappeared: an eruption on the south or south-east side of the new cone might be very dangerous.—**Y. Khouvine**: Study by means of X-rays of the chitin of *Aspergillus niger*, *Psalliota campestris*, and *Armillaria mellea*. Chitin of vegetable origin has not only the analytical characters of animal chitin, for example, the crayfish, but also has the same crystalline structure.—**Maurice Leriche**: The first fossils discovered, at the north of Angola, in the prolongation of the Lubilash strata, and the synchronism of the Lubilash and Lualaba deposits.—**A. and R. Sartory, J. Meyer**, and **E. Keller**: The determination of the quantity of magnesium contained in the essential foods and water of different communes of Alsace and Lorraine and its influence on cancer mortality.

Cape Town

Royal Society of South Africa, April 20.—**S. M. Naudé**: The spectroscopic determination of isotopes. Molecular spectra offer a much greater opportunity for the discovery of isotopes, since the mass of the constituent atoms of the molecule enters directly in the expressions for the vibrational and rotational energy of the molecule.—**B. F. J. Schonland** and **J. P. T. Viljoen**: A penetrating radiation from thunderclouds (see NATURE, Sept. 10, p. 399).—**M. Rindl** and **P W. G. Groenwoud**: A contribution to the chemistry of *Rauwolfia Natalensis*. The bark of the so-called 'quinine tree' (Koorsboom) is credited with possessing medicinal virtues. The cold alcoholic percolate furnishes: (*a*) Cane sugar. (*b*) An amorphous yellow alkaloid which, when administered orally or subcutaneously to cats in doses of 27 mgm. per kg. body weight, causes an elevation of temperature. The alkaloid has no definite melting point, and it resisted all attempts to obtain it or one of its derivatives in crystalline form. It is obtained by fractional precipitation of the aqueous alkaloid solution with sodium carbonate. (*c*) An amorphous alkaloid extracted from the aqueous alkaline solution with ether and giving the Rauwolfine reaction with concentrated nitric acid. (*d*) An amorphous alkaloid extracted from the aqueous alkaline solution with ethyl acetate and giving a fluorescent solution. This alkaloid does not give Rauwolfine reaction. (*e*) One or more alkaloids which appear to be very soluble in water and are not removed from the aqueous alkaline solution by shaking with immiscible solvents.

Rome

Royal National Academy of the Lincei, March 20.—**T. Levi-Civita**: Theorems of unicity and of existence for the small oscillations of a vortical thread of nearly circular form.—**L. Tonelli**: A theorem of the calculus of variations.—**S. Cherubino**: A property of oblique intuitive curves.—**J. Mirguet**: Certain new direct infinitesimal notions.—**G. Lampariello**: The instability of helicoidal vortices.—**G. D. Mattioli**: The reduction of degree of the canonical systems by means of generic integrals.—**N. Moisseiev**: The law of resistance to the motion of bodies in a pulverulent medium. (3) General case of an incoherent agitation.—**G. Supino**: Deformation of strips.—**G. Conti**: Contribution to the study of the variation of latitude.—**T. Alippi**: Certain peculiarities of the annual variation of the relative humidity. In relation to the recent communication on this subject by Viola, the author quotes the following conclusions drawn from various memoirs by Eredia (1908, 1919, 1931), dealing with observations made at a number of Italian towns. In coastal towns the moisture is lower in winter and higher in summer than in the interior of the country. On the seaboard the variations in the relative humidity, although marked, are less than in the interior. At Genoa and on the western Riviera generally, moisture is scanty (sometimes below 50) in January and reaches its maximum in summer and autumn; this anomaly is attributed by Eredia to the influence of air-currents.—**Maria Lombardini**: Calculation of the circuitation in the movements of the atmosphere.—**P. Straneo**: A new unitary theory of gravitation and electricity by absolute geometrisation. The author's studies on the unitary problem of macroscopic physics lead to a solution which, owing to its maximum generality and its extreme simplicity, appears to be definitive.—**G Devoto**: Investigations on the dielectric constant of liquids. (7) Dielectric constant and electric moment in aqueous solution. With the α-amino aliphatic acids, distinct proportionality exists between the dielectric constant and the electric moment; this is

confirmed by the results recently obtained for glycylglycine.—C. Jucci and C. Manunta: The colouring matter of the silkworm cocoons of the Japanese green race. This pigment, for which the name bombiclorin is proposed, dissolves very readily in water and only sparingly in alcohol, and forms yellow salts with alkalis.—M. Anelli: Folding of Pleiocene soils in the Reggian Appennines.—R. Pampanini: Plants collected in Libya by the Desio mission (1931).

Forthcoming Events

Societies

THURSDAY, SEPT. 22

OPTICAL SOCIETY.—Special General Meeting at the Imperial College of Science and Technology, at 5.30 P.M.

Congresses

SEPT. 19–24

BRITISH MYCOLOGICAL SOCIETY.—Annual General Meeting at the Haslemere Educational Museum, Surrey.

Wednesday, Sept. 21.—Miss G. Lister: "Field Notes on Mycetozoa" (Presidential Address).

SEPT. 21–23

FARADAY SOCIETY.—Second Colloid Meeting at Manchester. Discussion on the "Colloidal Aspects of Textile Materials and Related Topics".

SEPT. 23–26

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—Ninth Annual Conference at Somerville College, Oxford.

Friday, Sept. 23.—Sir Charles Sherrington (Presidential Address).

Prof. J. L. Myers: "The Relationship between Science and the Humanities".

Saturday, Sept. 24.—Dr. S. C. Bradford and Prof. A. F. C. Pollard: "Classified Subject Indexes to Periodical Volumes".

Prof. M. Greenwood: "History and Sources of Official Vital Statistics".

Official Publications Received

BRITISH

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 1, No. 9: Notes on Lower Old Red Sandstone Plants from Callander, Perthshire. By S. M. K. Henderson. Pp. 277-285+1 plate. 1*s.* 6*d.* Vol. 57, Part 1, No. 10: On the Structure and Function of the Alimentary Canal of the Limpet. By Alastair Graham. Pp. 287-308. 2*s.* 9*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1450: Reports and Memoranda published between 1st January 1931 and 1st April 1932. Pp. 8. (London: H.M. Stationery Office.) 6*d.* net.

Records of the Geological Survey of India. Vol. 65, Part 4. Pp. 445-541+lv+plates 19-29. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s.*

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 27: Zebu (Brahman) Cross Cattle and their Possibilities in North Australia. By R. B. Kelley. Pp. 64. Pamphlet No. 28: The Pig Industry; Report on Conditions in Great Britain and America, with Suggestions Applicable to Australia. By R. B. Kelley. Pp. 44. (Melbourne: H. J. Green.)

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 20, Memoir No. 2: *Homoxylon rajmahalense*, Gen. et sp. nov., a Fossil Angiospermous Wood, devoid of Vessels, from the Rajmahal Hills, Behar. By Prof. B. Sahni. Pp. iv+19+2 plates. (Calcutta: Government of India Central Publication Branch.) 1.12 rupees; 3*s.*

The Geology of the Baria State (Revakantha Agency). By R. Rama Rao. Pp. x+152+20 plates. (Devgad Baria: Secretariat Office.) 5 rupees.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1931. Pp. x+293+9 plates. (London: H.M. Stationery Office.) 5*s.* net.

Report of the Advisory Council of the Science Museum for the Year 1931. Pp. 40. (London: H.M. Stationery Office.) 9*d.* net.

Proceedings of the Royal Society. Series A, Vol. 137, No. A832, August 2. Pp. 243-480. (London: Harrison and Sons, Ltd.) 12*s.*

Empire Fibres for Marine Cordage: Sisal Hemp and New Zealand Hemp. Rope Tests (Fourth Series): Report of Investigations conducted by the Imperial Institute. Pp. 8. (London: Imperial Institute.) 6*d.*

The Indian Lac Research Institute. Bulletin No. 5: Humidity and Storage of Button Lac. By Dr. R. W. Aldis. Pp. 4. 8 annas. Bulletin No. 6: The Effects of Temperature and Humidity on Oviposition, Incubation and Emergence in the Lac Insect, *Laccifer* (*Tachardia*) *lacca*, Kerr. (Coccidae), and on the Resulting Lac Crop. By P. M. Glover, P. S. Negi, M. P. Misra and S. N. Gupta. Pp. 18. 1.4 rupees. Bulletin No. 7: Orpiment and the Iodine Value of Shellac. By M. Rangaswami and Dr. R. W. Aldis. Pp. 4. 8 annas. Bulletin No. 8: The Iodine Value of Shellac. By Dr. R. W. Aldis. Pp. 5. 8 annas. Bulletin No. 9: Comparative Study of Lac Hosts with Special Reference to Acacia Catechu and Cassia florida. By A. K. Thakur. Pp. 8. 8 annas. A Report on the State of Lac Cultivation and General Condition of the Lac Industry in Burma, 1931; with Appendices. By Dorothy Norris. Pp. 26. 8 annas. (Nankum, Ranchi.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), Nos. 23 and 24: A Method for Automatically Recording the Oxygen Intake of Living Tissues, by Dr. T. A. Bennet-Clark; The Respiratory Quotients of Succulent Plants, by Dr. T. A. Bennet-Clark. Pp. 281-299. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s.* 6*d.*

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 11: Studies in the Physiology of the Virus Diseases of the Potato; a Comparison of the Carbohydrate Metabolism of Normal with that of Leaf-Roll Potatoes. By Eustace Barton-Wright and Alan M'Bain. Pp. 309-349. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5*s.*

Department of Scientific and Industrial Research. Third and Final Report of the Adhesives Research Committee. Pp. v+109+7 plates. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

FOREIGN

Malayan Forest Records. No. 10: Dipterocarpaceae of the Malay Peninsula. By F. W. Foxworthy. Pp. 289+24 plates. (Kuala Lumpur: Forest Department.) 3.50 dollars; 8*s.* 6*d.*

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 142: Common Diseases of Cereals in Michigan. By J. H. Muncie. Pp. 54. Special Bulletin No. 220: Comparisons of Methods of making Spray Applications. By H. A. Cardinell and H. P. Gaston. Pp. 25. Special Bulletin No. 222: Garden Roses. By C. E. Wildon. Pp. 47. Special Bulletin No. 224: Marl, its Formation, Excavation and Use. By S. G. Bergquist, H. H. Musselman and C. E. Millar. Pp. 34. Special Bulletin No. 225: Spinach Varieties. By Harm Drewes. Pp. 48. Technical Bulletin No. 121: Fermentation Studies with Soft Wheat Flours. By C. P. Wilsie, C. S. Robinson and O. B. Winter. Pp. 39. (East Lansing.)

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 12: Research in Higher Education; Papers prepared for the First Regional Conference on Higher Education held under the joint auspices of the United States Office of Education and the University of Oregon, at Eugene, Oreg., April 14, 15 and 16, 1931. Pp. vi+133. Bulletin, 1932, No. 8: Safety Education; Helps for Schools in Constructing a Course of Study. By Florence C. Fox. Pp. iii+73. (Washington, D.C.: Government Printing Office.)

Publications of the Observatory of the University of Michigan. Vol. 4, No. 7: Atmospheric Pulsation in Eta Aquilae, Preliminary Results. By W. Carl Rufus. Pp. 101-108. Vol. 4, No. 8: Motions in the Atmosphere of Eta Aquilae. By David W. Lee. Pp. 109-128. Vol. 4, No. 9: The Light Curve of R Scuti, 1911-1931. By Ralph H. Curtiss. Pp. 129-133. Vol. 4, No. 10: The Light Variations of R Scuti from 1911 to 1931. By Dean B. McLaughlin. Pp. 135-149. Vol. 4, No. 11: Motions in the Atmosphere of Zeta Geminorum, Preliminary Results. By W. Carl Rufus. Pp. 151-162. (Ann Arbor.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 17. (New York City.)

Bernice P. Bishop Museum. Bulletin 92: Ethnology of the Tongareva. By Te Rangi Hiroa (P. H. Buck). Pp. iv+225+8 plates. Bulletin 93: Pteridophytes of the Society Islands. By Edwin Bingham Copeland. Pp. 86+16 plates. Bulletin 94: Report of the Director for 1931. By Herbert E. Gregory. Pp. 54. Occasional Papers, Vol. 9, No. 18: Fishes obtained at Samoa in 1929. By Henry W. Fowler. Pp. 16. Occasional Papers, Vol. 9, No. 19: Notes on Pritchardia. By Harold St. John. Pp. 5. (Honolulu.)

Norges Svalbard- og Ishavs-Undersøkelser: Skrifter om Svalbard og Ishavet. Nr. 37: Fazielle Verhältnisse des Mesozoikums im Eisfjordgebiet Spitzbergens; ein Beitrag zur Entwicklungsgeschichte des Skandiks. Von Hans Frebold. Teil 1. Pp. 94+6 Tafeln. 8.75 kr. Nr. 39: Flowering Plants of Franz Josef Land collected on the Norwegian Scientific Expedition 1930. By Olaf Hanssen and Johannes Lid. Pp. 42. 3.50 kr. Nr. 41: Lichens from North East Greenland collected on the Norwegian Scientific Expeditions in 1929 and 1930. By B. Lynge and P. F. Scholander. Pp. 116+7 plates. 9.50 kr. Nr. 42: Beitrag zur Kenntnis der devonischen Fischfauna Ost-Grönlands. Von Anatol Heintz. Pp. 27+6 Tafeln. Nr. 43-46: Some Vascular Plants from South East Greenland collected on the *Heimen* Expedition in 1931, Preliminary Report, by Bjørn Bjørlykke; Vascular Plants from South East Greenland collected on the *Signalhorn* Expedition in 1931, by Johannes Lid; Lichens from South East Greenland collected in 1931 on Norwegian Expeditions, by B. Lynge; Beiträge zur Hieraciumflora Ost-Grönlands, von S. O. F. Omang. Pp. 8+12+15+5. 4.00 kr. Nr. 47: A Revision of the Genus *Rhizocarpon* (Ram.) Th.Fr. in Greenland. By B. Lynge. Pp. 30. 2.00 kr. Nr. 48: Vascular Plants from Eirik Raude's Land. By Jakob Vaage. Pp. 87+3 plates. 7.00 kr. Nr. 50: Détermination astronomique de Mygg-Bukta au Groenland Oriental. Par Hans S. Jelstrup. Pp. 44. 3.75 kr. (Oslo: Jacob Dybwad.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 106: Cercospora Disease of *Calotropsis procera*. By Dr. R. M. Nattras. Pp. 6+7 plates. (Cairo: Government Press.) 3 P.T.

CATALOGUES

The B.D.H. Book of A.R. Standards. Second and revised edition. Pp. xii+194. (London: The British Drug Houses, Ltd.) 2*s.* 6*d.* net.

Books on all Technical Subjects and Applied Science. (Catalogue of Dept. 7.) Pp. 104. (London: W. and G. Foyle, Ltd.)