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Medicine and Science.

THE advancement of medicine is an object which can scarcely fail to be universally desired, and the discussion of the principles that govern it is therefore a matter of perennial interest. It is in itself an evidence of healthy life that such discussion should have been active of late and should have been contributed to influentially from several different aspects.*

The fundamental process at work in progressive medicine to-day is the gradual acquisition by it of the qualities of an applied science. Although this development must be regarded as the inevitable course of sound advance, it is beset by certain difficulties inherent in the very nature of the case which give to the situation of medicine a special interest from the point of view of method. One of these difficulties is the result of what we may call the historical setting in which science applied to medicine finds itself.

When science is given a wholly new contact with practical affairs, the applied science that thereupon grows up develops, as it were, in virgin soil, with nothing to hope from the co-operation or to fear from the conservatism of any antecedent practical art in the same field. In these circumstances, the new activity may develop uneventfully as a straightforward applied science; such, for example, has been, from this point of view, the situation of electrical engineering. When science is applied to a field already occupied by a vigorous practical art, however, the contact of the two different disciplines may result in a certain wasteful discrepancy of ideals and effort. In some degree this has been the situation of scientific agriculture in its relation with the ancient practical art of farming; it is still more clearly the situation of applied science in medicine. Here science finds the ground already occupied by one of the most ancient, vigorous, and learned of the practical arts. It must be recognised that the two disciplines, although in favourable circumstances capable of most fruitful co-operation, do not possess any strong natural affinity for one another. One of the aspects of this relative incompatibility is shown in the inveterate endeavour of science to bring every individual problem within the range of principles of general validity, while the strength of the practical art is its regard for the uniqueness of the individual case.

* The following contributions may be mentioned both for their importance and their representative variety of outlook: "Observations on Research in Medicine", by Sir Thomas Lewis, *Brit. Med. Jour.*, Mar. 15, 1930; "A Discussion on Research in Clinical Medicine", by Dr. J. Ryle and others, *Proc. Roy. Soc. Med.*, Oct. 28, 1930; "The Science of Medicine", by Lord Moynihan, the *Lancet*, Oct. 11, 1930.

A second obstacle that applied science in medicine has to overcome is inherent in the biological situation of man. It is the consequence of the wide gap in structure, and still more in function, that separates man from any other animal. The extent of this separation has perhaps not always been fully recognised; it is, however, undoubtedly of importance, not only in complicating the application to man of the results of animal experiment, but also because of the doubt it raises whether certain activities of man on which knowledge is urgently needed by medicine can even be illustrated, much less elucidated, by experiments on animals. The recognition of this difficulty has caused greater and greater attention to be given to the use of direct experimentation in man himself—the only means of acquiring knowledge about him that from the point of view of method is wholly unexceptionable. It is, however, of necessarily limited range, so that for the general progress of knowledge in scientific medicine we must continue to depend chiefly on animal experiment and on our ability to apply its results to man.

Although man's place in Nature has been and still is a favourite theme of the post-Darwinian biologist, it has, for reasons historically obvious, very naturally been defined chiefly with an eye to structure and to unities and resemblances with the rest of the living world. The time has now come when in the interests of medicine a more exact and critical orientation is necessary, which must concern itself essentially with function and not less with dissimilarities than with likenesses. On the elaboration of such a science of comparative function in health and in disease the progress of medicine is likely to come more and more to depend. Much of the material for such a study exists already in the immense accumulation of the facts of human behaviour made by clinical medicine from time immemorial.

In this connexion, some comment on the general value of the clinical method as an implement of research should perhaps be made. There can be no doubt that, as a method of fundamental inquiry, that characteristic of the clinical physician has been far outdistanced by that of strict scientific experiment. This fact has led to the suggestion that the time-honoured method of the clinician, the method of Addison and Bright, of Paget and Hughlings Jackson, has little or nothing to offer for the future of medicine. Since the acceptance of this doctrine could scarcely fail to have important practical consequences, some examination of it is desirable. The great strokes of the clinical method have usually been made by the use of observation acute and patient rather than systematic, with a certain amount of not very strict experiment, both guided by a penetrating intuition and a profound familiarity with the subject of inquiry. These successes have therefore been won by men whose mental powers enabled them to use an imperfect instrument with a certain large indifference to its defects. Lacking the intuition of his great predecessors, the clinical worker must pay more attention to perfecting the instrument if he is to get substantial results. Every opportunity to introduce standards of scientific severity must be taken, observation must be systematic and exact, and the most must be made of any occasional chance to submit an issue to experiment. Purely clinical inquiry never has been and never can be the equal of experiment in the attack on a problem stage by stage until a final solution is reached, but if every opportunity is taken to naturalise in it standards of scientific severity, it has within its range innumerable important problems that it should be thoroughly able to solve.

Whatever successes may await a clinical medicine thus oriented more definitely towards the standards of science, there can be no doubt that it is the experimental method, in all its severity and in the hands of the appropriately educated expert, on which the substantial progress of medicine essentially depends. How best this great instrument can be directed upon the work before it is a matter on which very naturally there is difference of opinion. Perhaps the most important practical problem yet in discussion is to decide the relative claims of what have been called 'free' research and 'directed' research: that is to say, inquiry which follows the natural evolution of its subject, and inquiry in which specific problems are allotted to the worker for solution. There can be no question that in the sciences on which medicine depends, as in all other sciences, complete freedom of research is indispensable; however academic, however remote from any kind of usefulness inquiry following its own course may seem to become, any restraint, in the supposed interests of practical ends, is wholly inadmissible. There is, however, another aspect of the case which must be considered. The practical clinician finds himself surrounded by problems which seem soluble by skilled experiment and of which solutions are urgently necessary in the interests of his art. He sees that the great bulk of research in physiology and even pathology has little or no direct bearing on his immediate difficulties. Aware as he is that one of the most effective

instruments used by these sciences—operative surgery—was given to them by his own art, he cannot but feel that the debt might be repaid in some more tangible form than has yet been the case.

The demand by the clinical worker that in his special problems he should have at his disposal the full advantage of skilled experimental research, just as it doubtless is, can obviously not be met by deflecting resources now devoted to 'free' research. It seems to call for establishments specially directed to the purpose and staffed in part by those whose ultimate interests are likely to be in some branch of the practical art, but who by serving an apprenticeship in experimental science would contribute to the advancement of practical medicine directly by working on its problems and indirectly by infiltrating its ranks with the scientifically trained. In a remote way, the same interests, as well as those of the whole of human biology, are being served by that re-discovery of man which is now so happily at work in the physiological and pathological fields. It is earnestly to be hoped that this process will continue, for by bringing clinical and scientific workers together it will help the experimental sciences in their not always successful struggle against orthodox rigidity, and will help the ancient practical art of medicine in its difficult transformation into an applied science.

The Anthropology of Africa.

Descriptive Sociology or Groups of Sociological Facts classified and arranged by Herbert Spencer. Division 1, No. 4, Part 2-A: *African Races* (*Pygmies, Bantu, Equatorial Hybrid Tribes, Sudanic Peoples, Nilotics, Nilo-Hamitics, Fulani, Khoisan*). Compiled and abstracted upon the Plan organized by Herbert Spencer by E. Torday. A re-issue of the Volume originally compiled by Dr. David Duncan, entirely re-written. Issued by Mr. Spencer's Trustees (T. W. Hill, Editor). Pp. vii + 385. (London: Williams and Norgate, Ltd., 1930.) 105*s.* net.

ONE of the most telling symptoms of vitality in science is the fruitfulness of its practical applications. Anthropology, the science of man, has so far kept almost completely aloof from any direct concern in human affairs, as sublime an example of sterility beautiful as the theory of numbers. But this is an anomalous condition, and at present public interest as well as political conscience are moving towards a better understanding of the governed races so that they might be better governed.

The centre of colonial studies at Oxford, Rhodes House, the International Institute for the Study of African Languages and Cultures, with its principal seat in London, developments at various universities in Great Britain, and such valuable literary contributions as Buell's "Native Problem in Africa", are all signs of this gathering interest.

It is only fair that an anthropologist, specially keen about the practical applications of his science, should pay tribute to NATURE for the part it has taken in the movement of humanising anthropology and making it more efficient. If anthropology ever becomes an acknowledged force in colonial affairs and receives the full academic recognition which is its due, this will be, to a considerable extent, thanks to the good offices of NATURE. At present it is well to put on record that there is but one full-time chair of anthropology in the British Isles; the teaching of colonial cadets is not carried out at all in the University of London, where this chair exists; and in those universities where the colonial probationers are trained, anthropology is an optional subject and is confined to what must be a ridiculously inadequate smattering of twenty hours in all. This, of course, is negligible, especially if we remember that in other countries, with a colonial tradition as long as that of Holland or France or as short as that of Belgium, from three to five years are required for the special training of future administrators. This does not mean to say that an anthropologically trained Belgian administrator has shown himself so far to be better than an untrained Britisher, but that the educated British official would probably be the best of all.

The present volume, Mr. E. Torday's "African Races", brings these reflections to the reader's mind. The book deals with Africa, which is by far the most important continent as regards colonial problems; and it is written by a scholar of international reputation. Mr. Emil Torday is at once a pioneer field-worker, a man of full academic qualifications, though without formal academic claims, and one of the supporters of what is now known as the 'functional school of anthropology', a school which has been foremost in the application of anthropological theory to practical affairs.

The functional school explains institutions, customs, and beliefs, not by their antecedents but by the part which they play as living forces within a living culture. Functional anthropology consists in new methods and a body of principles which have arisen out of field-work, and which,

on the other hand, are largely inspired by the need for practical applications. Modern field-work, done by trained specialists with a good knowledge of native languages and over periods of prolonged residence, has forced us to recognise that whereas it is easy to collect a body of formulæ as to what natives are supposed to do, it is difficult to describe how ideas, customs, and institutions actually work in tribal life. The dynamic study of a primitive society reveals that human culture is a very complex type of reality, subject to scientific laws of its own. The discovery of the laws of cultural process and of the functional relation between its various aspects and elements is the main field of functional theory.

A theory giving clear insight into the nature of culture is indispensable for anyone who sets out to make observations on a hitherto unrecorded type of human society. No student of exact science or of biology would dream of sending a plumber or a bookmaker or a lady typist into the laboratory and of relying upon his or her amateur observations. Experiments done without theoretical preparation or knowledge of the problems would, as a matter of course, be regarded as worthless in physics, chemistry, or biology. Yet in anthropology we have so far been forced to rely on amateur observations, often given without any description of the method and the apparatus by means of which they were made.

Worse than that: when trained specialists recently started to collect their own material in Africa, Oceania, or the South American jungle, they had no empirical theory as to the nature of primitive culture, that is, of the reality which they were setting out to observe. What they were given were hypothetical speculations of the retrospective schools, the evolutionists and the diffusionists. But the theories of origin or of historical migrations transplant us in their explanatory setting into a dim past—from six to sixty thousand years back. The observer, as often as not a partisan of one theory or another, had his mind turned backwards, riveted on hypotheses and conjectures which made him see the present through the haze of the past; which made him focus on details and elements significant not in their actual context and in their mutual relations, but as relics of something which was no more and, except in speculation, had perhaps never existed.

Functional anthropology aims at the reproduction of the native point of view and the native perspective combined with sociological knowledge of what is essential and vital in human institutions. The details of daily life, for example, the organisation of the household and the family, the type of economic activities, the sanctions of law and custom, which so far have received but little attention, have come to be, in functional research, of primary importance. All that really matters to the native, all that really serves to maintain order and integrity in a primitive culture and primitive society, is selected as the main subject for anthropological study. It is clear that such a reorientation of field-work and theory alike by the criteria of dynamic relevancy brings functional anthropology immediately into touch with practical concerns.

Mr. Emil Torday is one of the pioneer minds in this new school. His field-work, carried out under ideal conditions, that is, during prolonged residence and through the medium of the vernacular, gives us a full picture of tribal life and is never confined to curious and sensational details.

In the present computation of facts, Mr. Torday proceeds throughout according to the rules of the functional method, that is, by the criteria of relevancy, function, and social value. As is the case in all scientific work, it is the selection which really matters, the emphasis on the relevant, the subordination of the accidental. In doing this, Mr. Torday had an ardous task, for he was severely handicapped by the exacting conditions of the Herbert Spencer Trust, which lays down the subject matter, the headings, the order, as well as the relation between the geographical and the systematic divisions of the material. By the introduction of a concise but extremely helpful table of contents, by adding illuminating sub-headings and cross-references, Mr. Torday was able to palliate some of the inadequacies of the original Herbert Spencer plan. By adding copious critical notes to the quotations, Mr. Torday places the data in the right perspective, correlates the observations of the various authors, and establishes the functional aspect of the material at his disposal. But it seems necessary once more to urge the Trustees, who, I know, are fully aware of the inadequacies of the present plan, that energetic steps should be taken to a complete revision of the bequest.

As it stands, the book is a most tantalising production. The field-worker, the administrator, the missionary, and even the traveller could use it with the greatest profit on the spot in Africa. But how is he to carry a volume 1½ ft. by 1 ft. and some twelve pounds in weight unless a special means of

transport and a scaffolding or lectern be provided to read it? It would be necessary in the wilds of Africa to charter an elephant, a camel, or at least an ass or a Ford lorry in order to make it the 'handy guide-book of Africa', to which title it has full claim. Had it been published in a portable size, and had it been allowed to Mr. Torday to divide the material geographically, this book might have consisted of several volumes, each relevant to one particular area, each portable, and the whole of the greatest practical utility. Again, it is a thousand pities that a writer of Mr. Torday's eminence should be compelled to make a mere compilation with comments and cross-references only, and limit his original contribution to an all too short preface. This, written with the weight, attractiveness, and convincing clarity for which Mr. Torday is well known, among others through his "Causeries Congolaises", contains a brief exposition of the functional point of view, illuminating sidelines on the nature of African races, especially of the Hamites, Pygmies, and the Bantu, and it gives us also a summary of the enormous advances attained by African studies since 1875, when the first version of "African Races" had been contributed as a volume of Herbert Spencer's "Descriptive Sociology".

The excellent map contributed by Miss Ursula Torday will be a boon, not only in the use of this volume, but also for African anthropology in general.

B. MALINOWSKI.

Conduction in Electrolytes.

(1) *Electrolytic Conduction.* By Prof. F. H. Newman. Pp. xii+441. (London: Chapman and Hall, Ltd., 1930.) 25*s.* net.

(2) *The Electrochemistry of Solutions.* By Dr. S. Glasstone. Pp. x+476. (London: Methuen and Co., Ltd., 1930.) 21*s.* net.

THE study of physical science is extraordinarily fascinating nowadays. We see much farther, even if we see a little less clearly than our grandparents saw—or thought that they saw. Our most innocent experiments and observations are weighted with philosophical and theological implications of cosmic importance. We make measurements that are each year more and more exact, and find ourselves committed to a principle of indeterminacy. We read of a quantum mechanics which, in a praiseworthy endeavour to escape from those mechanical pictures which are based on an extrapolation of our large-scale experiences, employs a symbolism in which the exact nature of the symbols employed remains unspecified. *Naturam expellas furca . . .*, and the heroic exponents of these latest symbolic methods—latest, though not novel, for are they not closely related to the ideals of Kirchhoff?—find themselves compelled, willy-nilly, to use terms and concepts based on those of our everyday experience.

It is all very interesting, but it is none the less pleasant to find that there are corners in the realm of science where a consistent scheme can be built up on a basis of 'ordinary' space-time perceptions, where the principle of indeterminacy is not, where the motion of ions through a viscous fluid is determined (perhaps a little doubtfully) by Stokes's law, and where a modern theory of strong electrolytes may be based on nothing more unusual than Boltzmann's principle and Poisson's equation. The theory of electrolytic conduction and the technique of the measurements associated therewith are in a state sufficiently stable to make it worth while to attempt an assessment of the condition of this important branch of physical science, and the two volumes here reviewed cover the topics of greatest importance in a very comprehensive and systematic manner.

(1) Prof. Newman's book is written by a teacher who has a lively and sympathetic appreciation of the difficulties which confront an intelligent and conscientious reader. The work, which will provide stimulating reading for a university student of honours grade, builds up the subject from the very elements. In a laudable desire to give the reader all that he needs between the covers of a single volume, the author leads off with a condensed but very clear sketch of thermodynamic principles, which includes a discussion of the usual relations between osmotic pressure and boiling or freezing points, of thermodynamic potential and free energy, of the Nernst heat theorem, the phase rule, and the Gibbs adsorption equation. Condensation has its dangers, however, and, admirable though the summary is, we confess to a dislike of the dictum that $\Sigma\,(dQ/T) < 0$ for an irreversible cycle; while the unadorned statement that, if δQ is the amount of heat passing (by conduction) from a body at a temperature T_1 to a body at a temperature T_2, then the net gain of entropy is $(\delta Q/T_2) - (\delta Q/T_1)$, raises more doubts than it resolves.

The main body of the book covers a wide field. Starting from the fundamental Arrhenius concept of spontaneous dissociation, the author develops a general view of the problem of electrolytic conductance, and then proceeds to treat in detail of ionic migration, ionic equilibria, cells and electro-

motive force, electro-capillarity, polarisation, the measurement of electrolytic resistance, theories of electrolytic solution, and technical applications. A reasonably full bibliography accompanies each chapter, and a reader who has used the book intelligently will find its perusal a very useful preparation for an attack on research problems in electrolysis.

It has been the reviewer's experience that one branch of experimental work, and that branch one of fundamental importance, has been shrouded in a quite unnecessary mystery. We refer to the measurement of electrolytic resistance, where it is not uncommon to find an experimenter capable of, and actually making, very precise determinations with but a cloudy idea of the exact conditions under which inductance and capacity effects are balanced out, and of the relation between impedance and resistance. Prof. Newman's chapter on electrolytic resistance measurement, wherein he discusses very clearly and straightforwardly the application of the ordinary alternating current equations to the bridge system involved, should do useful service in dispelling this mystery. His descriptions and diagrams of the experimental methods used, including that of a valve oscillator as a source of alternating current, are clear and up to date. But we note that he begins the chapter with the remark that " as shown by Kohlrausch

$$E_0 \sin pt = Ri + P\int idt \text{ ",}$$

developing the theory from this equation. Prof. Newman has been so thorough, within the limits of his four hundred and forty pages, in his treatment of fundamentals that it seems a pity that he should pass over this important expression without more detailed discussion, and we trust that in a later edition of his work he will remedy this omission.

The chapter on theories of electrolysis gives a very useful résumé of the various theories of strong and of weak electrolytes, and the exposition of the Debye-Hückel theory and of the subsequent developments by Onsager is very clearly put.

(2) The bias of Dr. Glasstone's treatise is indicated by its title, being, as compared with Prof. Newman's book, considerably fuller in its discussion of those topics which are usually associated with an advanced course of physical chemistry. He, again, starts from the fundamentals, and while his discussion of the methods and theory of resistance measurements is a little more restricted than that of Prof. Newman, he gives us a more detailed treatment of topics such as overvoltage, depolarisation, the theory of amphoteric electrolytes, and the theory of reversible cells, which last topic is treated in very considerable detail.

In discussing the elementary theory of ionic migration and concentration changes, Dr. Glasstone makes use of the usual picture of chains of oppositely moving positive and negative ions ; it would add much to the interest of his treatment were he to give some reference to the critical paper dealing with this method of illustrating the process which was read by Prof. S. W. J. Smith some years ago before the Physical Society (*Proceedings of the Physical Society*, **28**, 148 ; 1916). Neither book contains a reference to the simple and elegant algebraic treatment of this problem which was advanced by Larmor in his Adams prize essay on " Æther and Matter " (p. 289, Appendix C, on Electrolysis).

The choice of topics lies entirely within the author's province ; but the reviewer feels that it would add considerably to the value of an interesting treatise were Dr. Glasstone to consider in some little detail Smith's very interesting experiments on the potential difference developed at the interface between two electrolytic solutions, and on the related problems of the asymmetric nature of the surface tension potential curve for a capillary electrometer.

The two books are in some measure complementary and, taken together, give a conspectus of results and theories in this department of physical science which will be invaluable to physicists and to physical chemists, and will provide the research student with a mine of indispensable information.

ALLAN FERGUSON.

The Passing of Woad.

The Woad Plant and its Dye. By the late Dr. Jamieson B. Hurry. Pp. xxviii + 328 + 17 plates. (London : Oxford University Press, 1930.) 21*s*. net.

BRITAIN has always been fortunate in its amateur scientific workers ; men, by no means real amateurs in science, who find delight in the intervals of a busy life in following seriously some definite line of investigation. Of this category was the late Dr. Hurry, who, in the midst of a very crowded career as a medical practitioner in Reading, was yet able to study systematically and as a most careful monographer to render signal service to knowledge. Quite why he chose to tell the story of the woad plant is not revealed, but he had a lifelong interest in economic botany and at his home he established an educational garden and

museum. The woad plant and its famous blue dye are studied from an international point of view, and the book aims both at giving a comprehensive account of the industry in several countries and emphasising so many other points of view that it becomes a contribution to our knowledge of the social and industrial life of the Middle Ages.

Successive chapters deal with the cultivation and manufacture of woad, its use in the fermentation vat, the extraction of the glucoside, indican, succeeded by an historical account of the industry in Britain, France, Germany, and Italy. Economic questions have next place, followed by a full account of the old-world lore relating to the place of woad in herbals and in therapeutics. Final sections are devoted to the protection by legislation and the death of the woad industry.

Dr. Hurry's name is a sufficient guarantee of the thoroughness and careful attention to detail which characterise the book; withal it is attractive reading for those who appreciate broad and liberal treatment of what might appear to be a specialist subject. There have been two crises in the woad industry. The first was when in the seventeenth century trade routes were opened up to India and the dye, extracted from material made in Europe, was threatened by imports from that country. The Dutch East India Company, formed in 1631, in course of time imported sufficient indigo into Holland to supply the needs of the whole world. At much the same time, logwood and Brazil wood also appeared on the scene, so there is little wonder a strenuous campaign took place to secure protective legislation in favour of the indigenous dye; the woad merchants were so successful as to induce various governments to prohibit entirely the use of exotic indigo. Even the death penalty threatened those who infringed the protective laws then passed. As is well known, protection failed; the superiority and the cheapness of exotic indigo could not be gainsaid. In Germany, too, the Thirty Years' War destroyed the woad fields and the villages of Thüringia.

The second crisis was due to the advance of synthetical organic chemistry. Synthetic indigo was first made in the laboratory, starting out from aniline; and then after some years of persistent effort, at the time regarded as a model piece of industrial research, and the expenditure of very large sums of money, its economical industrial production was achieved shortly before 1900. A fierce struggle between the natural and the artificial product ensued, fought with the utmost energy and often bitterness on both sides. Indigo planting in India became no longer profitable, and though scientific methods were introduced, yields increased, costs reduced, the natural indigo could scarcely hold its own. With the advent of the World War, first England and then the United States became makers of synthetic indigo, and at its conclusion joined battle with Germany primarily to secure the Chinese market. Costs were drastically and suddenly reduced so that the natural product received its death-blow overnight. To-day indigo is cheap enough, but it is doubtful if the makers profit: the gain goes to the Chinese.

The economic history of woad is matched in interest by its botanical and by its chemical significance and by the legends which surround it. The chemist has synthesised in his laboratory both indigo the dye, indican the glucoside, and also bromoindigo and its glucoside "the purple of the ancients", the Tyrian purple of the Roman emperors, who obtained it from the tongue of a deep-water mollusc. Indigo was first brought to Rome about A.D. 50, so that the purple is of older date than the blue.

The carpets at the Persian Exhibition in London have taught us anew of the wonderful and permanent colours obtained from plants—woad, madder, Persian berries, and many others should be grown at Kew and elsewhere suitably labelled to remind us of the contents of Nature's paint-box.

E. F. ARMSTRONG.

Our Bookshelf.

Das Tierreich: eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Lief. 52: *Myriapoda.* 1: *Geophilomorpha.* Bearbeitet von Dr. Graf Attems. Pp. xxiii + 388. 60 gold marks. Lief. 53: *Crustacea Copepoda.* 2: *Cyclopoida Gnathostoma.* Bearbeitet von F. Kiefer. Pp. xvi + 102. n.p. (Berlin und Leipzig: Walter de Gruyter und Co., 1929.)

Two further parts of this great work have recently appeared, in each of which the literature of the respective subjects up to the beginning of 1929 has been considered.

(1) Dr. Graf Attems prefaces the systematic part of his volume by an account of the external features of the Chilopoda and of the epidermis and its glands; including the unicellular ventral glands of the Geophilids, each cell of which is enveloped by a network of striated muscle fibrils. There is a brief reference to the sense organs. The characters of the order Geophilomorpha are stated, the features of systematic importance are described, and a table is given for the separation of the ten families. The

subsequent treatment follows the usual lines, with which those who have used the previous parts are familiar—a definition of each family, a key to its genera; a definition of each genus, and keys for the constituent species and subspecies. 128 recognised genera and 452 species are described; but there remain 17 genera and 190 species the position of which is uncertain, owing to insufficient diagnosis by their respective authors. An appendix is devoted to an account of about a score of species, for the most part described after the preparation of the body of the work.

(2) The first suborder of the Copepoda—the Calanoida—formed the subject of the sixth volume (1898) of this work. The present author briefly states the characters of the second suborder, the Cyclopoida, and its three sections, the Gnathostoma, Siphonostoma, and Pœcilostoma. The first of these sections forms the subject of this part. Three families with 18 genera and 192 definite species are considered. About 50 additional species are of uncertain position. The author appears to have overlooked two new species of *Cyclops* described by G. S. Brady in 1910. This part will be of use not only to marine and fresh-water zoologists, but also to helminthologists who desire to determine the species of *Cyclops* which they find acting as intermediate hosts—for example, for the broad tape-worm of man and for the guinea-worm.

Each part has a systematic index and *nomenclator generum et subgenerum*.

A Newton among Poets: Shelley's Use of Science in Prometheus Unbound. By Prof. Carl Garbo. Pp. xiv+208. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1930.) 13*s.* 6*d.* net.

THIS valuable and interesting book is another proof of the breadth of mind with which American professors so often pursue their studies. The bulk of the book is taken up by a summary of the scientific theories of Shelley's time, and especially of the work of Humphry Davy and the poems of Erasmus Darwin which had appeared just before Shelley wrote his "Queen Mab" and "Prometheus Unbound". The result of applying these to the elucidation of the poems, and especially of the "Prometheus", is highly curious and instructive. It was well known before that Shelley was passionately interested in science and fond of experiments in chemistry and electricity. His father is reported to have once returned a book on chemistry which Percy had borrowed, because it was "a forbidden thing at Eton"; and Prof. Whitehead, in "Science and the Modern World", quotes a notable example of Shelley's power of visualising an astronomical relation. But no one before Prof. Garbo has gone through the "Prometheus" thoroughly with this thought in mind, and his conclusions generally command assent. It is obvious that Shelley's mind was steeped with the science of the time, and many of the most beautiful and transcendent passages are chemical or electrical experiments transfigured by poetic genius. One might almost think that Shelley was consciously trying to carry out the ideal of the poet of the future which Wordsworth sketches in the famous preface to the second edition of the "Lyrical Ballads" (1800). "The remotest discoveries of the Chemist, the Botanist or Mineralogist will be as proper objects of the poet's art as any upon which it can be employed. . . . And what is now called science, thus familiarised to men, shall put on, as it were, a form of flesh and blood, the Poet lending his divine spirit to aid the transformation." We commend a consideration of this further connexion to Prof. Garbo for his second edition. F. S. M.

Life and Evolution: an Introduction to General Biology. By Prof. S. J. Holmes. Pp. v+449. (London: A. and C. Black, Ltd., 1931.) 12*s.* 6*d.* net.

AN elementary text-book of biology, written by the professor of zoology in the University of California, and designed, not so much to prepare students for further specialisation in a branch of biology, as to give a general view of biological problems to those whose main energies are going to be directed in other fields. The book is comprehensive in scope, ranging from protoplasm and the cell theory, through the different forms of plant and animal life, to heredity, evolution, and eugenics.

Prof. Holmes's book was originally published in the United States, and that edition was reviewed in NATURE of June 5, 1926. For the British edition, now before us, a number of minor revisions have been made in the text, and about twenty of the illustrations have been changed or improved. The most important revision, however, is the anglicising of the spelling throughout and the complete remodelling of the bibliography at the end of each chapter for the benefit of British readers. Otherwise the book is identical with that already published in America.

Air Ministry: Meteorological Office. The Meteorological Glossary. (M.O. 22511.) Second edition, entirely rewritten. In continuation of *The Weather Map.* Published by the Authority of the Meteorological Committee. Pp. 233+12 plates. (London: H.M. Stationery Office, 1930.) 4*s.* 6*d.* net.

THIS glossary shows signs of very thorough revision and is full of information in a compact and handy form, thereby fulfiling some of the functions of a text-book. There are charts and numerous diagrams, and a good deal of statistical and descriptive information about the climate of Great Britain is given under several of the headings, particularly in the section on rainfall. It is difficult to think of any term in any way connected with meteorology that is not given a place in the bold-type headings, and the names equivalent to the English of a number of meteorological phenomena are given at the end of the volume in several languages, at the request of the International Meteorological Committee. References in the articles to matters dealt with in other parts of the glossary conveniently appear in italics.

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.*]

Stellar Structure.

ZANSTRA'S recent determination of the temperatures of the *O*-stars in planetary nebulæ [1] makes it appear extremely likely that these stars are all generically in the 'white dwarf' class, with mean densities far above anything known on the earth. He has found temperatures between 30,000° and 100,000° for about twenty of these objects, and yet their luminosities are comparatively small. For a fairly typical nebular nucleus we may assume a photographic magnitude of 12·5 with a parallax of 0·002″, making the absolute magnitude +4, or about eight magnitudes fainter than typical galactic *O*-stars. It is, of course, true that the luminous *efficiency* falls off with rising temperature in this range, but an increase in temperature at constant radius must always involve an increase in brightness, proportional, even in the farthest part of the Rayleigh–Jeans region, to at least the first power of the temperature. Thus these stars must be of very small radius.

Zanstra obtains his figures from the difference between the measured brightness of the star and that of the nebula, which latter is assumed to be excited by the main (Schumann region) radiation of the star, and to convert all of it to long wave-lengths. The nebula thus performs the correction from visual to bolometric magnitude for us, as it were; if it does not do so completely, the star must be still hotter than is calculated. The correction is found to vary between 2 and 7 or 7·5 magnitudes; in an average case it would be about 5 magnitudes, and the temperature would be rather more than 55,000°. Such a star would then be about 5·9 magnitudes brighter than the sun bolometrically, with ten times its surface temperature; this means a radius 1/43 of the sun's, so that even with the sun's mass its density would be more than 100,000 gm./c.c.

The masses are, however, certainly greater. In a typical planetary, the line-of-sight rotational velocity can be taken as 5 km./sec. at 6″ from the nucleus, and with a parallax of 0·002″ this gives a mass 80 times the sun's.[2] If the gas is partly supported by radiation pressure, or if the axis is inclined to the line of sight, the figure comes out even greater. This may be set off against the allowance for the mass of the nebular envelope. The data indicate, therefore, a mean density of 10^6 or 10^7 gm./c.c., which is greater than has even been suggested for any other bodies, and points conclusively to a degenerate state of matter.

These bodies appear to be at the upper end of a sequence of 'white' dwarfs, as may be seen from the following summary:

	M_v.	Spectrum.
Planetary nuclei . .	+4	*O*
o Ceti *B* . . .	6	*B*8*e*
o^2 Eridani *B* . . .	11	*A*0
Sirius *B* . . .	10	*A*5
van Maanen's star . .	14·5	*F*
Wolf 489 . . .	13	*G*

It looks as if this sequence were roughly parallel to the main sequence, probably separated from it by a sparsely populated band, and with considerable scattering within it; at least, the general trend is evident, and the reason why no red stars of the 'collapsed' type have been discovered is of course obvious.

There are grave difficulties in the assumption that the source of energy within these white dwarfs is of the same nature as that within giants and main sequence stars, so that it seems worth while to point out that they have no very obvious need for a subatomic source at all. Just before degeneracy sets in, the internal temperatures must be of the order of at least 50 times those of a main sequence star built on the 'diffuse' model, or fully 10^9 degrees; Milne's calculation for the companion of Sirius [3] indicates a central temperature not exceeding (but apparently approaching) 3×10^9 degrees. The rate of radiation of such a star is only about 1/100 of that of the sun, or say one calorie per gram in 60 years; taking the specific heat as 3 (when the gas is still on the edge of degeneracy) we see that there is an internal store of heat sufficient for radiation at the white dwarf rate for something of the order of 10^{11} years. Of course, the very fact that the star is about to become degenerate means that not nearly all the kinetic energy of the nuclei and electrons will actually be available for radiation; much of it must remain as zero-point energy permanently in the star. But against this we must set the further energy to be obtained from such contraction as is still possible; at these small radii this energy is large. On the whole, then, the life of a white dwarf comes out, without any subatomic sources, entirely comparable with that of any star that derives its energy from the transmutation of hydrogen into heavier elements.

If the available subatomic energy of a main sequence star is exhaustible, the period spent in the main sequence will be followed by one of gravitational contraction; in the early stages this will be rapid, because the radius is large, and because at least half the energy gained will go into heating the interior of the star; in the late stages, the internal temperature will actually be falling, gravitational contraction will be very effective (if degeneracy is not too marked), and the rate of radiation will have become small. The fairly late stages will therefore be passed through very much more slowly than the early ones, and there will be a marked statistical concentration of the stars at radii perhaps two or three times the minimum figures calculated by Milne for a fully degenerate star. The minimum values are roughly $M^{-1/3}/80$ times the sun's radius, for a star of mass M times that of the sun, and where the masses are known the radii are all of about the anticipated size. Particularly high densities are clearly to be expected for the *O*-stars. In van Maanen's star, with a radius of 0·007 times the sun, it is tempting to suppose we have a massive star in a very late stage indeed; if Milne's formula is applicable, the mass must be at least 8 times the sun, which would mean an Einstein shift corresponding to at least 700 km./sec. This could easily be tested by observation.

It is worth remarking that in a century or less the true radial velocity of a star of such large proper motion and parallax as this could be found from the second order term in the proper motion; the relativity effect, even if much smaller than 700 km./sec., could then be fairly definitely determined.

However that may be, we have now fairly good evidence that stars of all masses can 'die'; this does not prove that transmutation rather than annihilation of matter is the source of stellar energy, but it clearly favours it. For Milne's theory leads to the conclusion that a mainly or nearly degenerate star will have a central temperature that may be much less than, but cannot be greater than $3{\cdot}9 \times 10^9 M^{5/6}$, and this seems inadequate to stimulate a source of energy that was

not active in the main sequence, especially if all stars have dense hot cores, as Milne believes. Thus the very latest stages of degeneracy, where the specific heat is small and contraction difficult, must be run through rapidly, and the total duration of the white dwarf stage probably is not much greater than we have already calculated. The probable relative abundance of white dwarfs is then somewhat difficult to reconcile with a time-scale of 10^{13} or 10^{14} years, but fits well with the transmutation theory time-scale.

The view that the nuclei of planetary nebulæ are 'white dwarfs' has, we now find, already been propounded by Jeans in "The Universe Around Us", pp. 309-311. That we had both failed to notice this can be excused, if at all, only by the great popularity of the publication in which the theory was announced, but we sincerely regret the oversight. In the application of this result we differ from Jeans, since he tentatively placed these stars at the beginning of stellar evolution, while we place them, with the other white dwarfs, at the end.

H. N. RUSSELL.

Princeton University.

R. D'E. ATKINSON.

Rutgers University,
Mar. 31.

[1] *Zeit. f. Astrophysik*, **2**, p. 1; 1931.
[2] Cf. Russell, Dugan, and Stewart, "Astronomy", p. 835.
[3] *Mon. Not. R.A.S.*, **91**, p. 39; 1930.

Emission Bands in the Mercury Spectrum under Low Excitation.

SOME years ago I found a long series of diffuse bands from λ2943 to λ2614 in the absorption spectrum of a long column of mercury vapour.[1] The same series was found independently and about the same time by Mohler and Moore.

Up to the present, these bands have never been obtained in emission. I now find that when mercury vapour is fluorescing under the iron arc (excitation from λ2650 to λ2537) these bands are emitted, and in much greater intensity if the vapour is superheated. The continuous emission from about λ2950 to λ3600 (maximum at λ3300) is also much increased by superheating, while the green visual fluorescence is extinguished. So far as my experiments go, the emission bands seem to be in close relation to this continuous emission at λ3300, though I am not prepared at present to say that this is invariably the case. Much longer exposures are required for the bands than for λ3300, but when such exposures are given, the bands appear as a kind of prolongation of the continuous emission. The continuous region, it is to be noted, is at the less refrangible end of the band series, where the band spacing is widest, and not beyond the convergence point, and this continuous region, unlike the bands, is not known in absorption. It will be important to examine the absorption of the superheated vapour.

The remarkable phenomena connected with the band spectra of mercury, and the long time of duration of the emission, are very complicated, and I think that speculation has rather outrun our knowledge of the facts, which is by no means adequate. It is my aim to find out as much as possible under conditions of low frequency excitation, less than the frequency of the atomic resonance line λ2537. These conditions should reduce the problem to its simplest form.

RAYLEIGH.

Terling Place, Chelmsford,
April 20.

[1] *Proc. Roy. Soc.*, A, vol. 116, p. 705; 1927.

Proton and Electron.

THE ratio of the mass of the proton, M_P, to that of the electron, m_e, is a pure number which is likely to be of considerable importance in physical theory. In a recent letter, Dr. W. N. Bond[1] has deduced for this ratio the value $1846{\cdot}5_7 \pm 0{\cdot}4_8$ with a probable error which should be accurate to about ten per cent. This is very close to the 'deflection' value of Birge,[2] $1846{\cdot}61 \pm 2$, but larger than the 'spectroscopic' value $1838{\cdot}26 \pm 1$.

The suggestion of A. P. Mathews that

$$\frac{M_P}{m_e} = \left(\frac{135}{\pi}\right)^2 = 1846{\cdot}58$$

gives remarkable numerical concordance with Bond's estimate, but it seems, at present, to have no theoretical significance.

As Dr. Bond has pointed out, the relation proposed by Rojansky[3] and also by Eddington,[4] which gives

$$\frac{M_P}{m_e} = \frac{(136)^2}{10} = 1849{\cdot}6,$$

is not in good agreement with recent experimental determinations.

The same objection applies to Witmer's hypothesis[5] that

$$\frac{M_P}{m_e} = (43)^2 = 1849.$$

I venture to add one more suggestion to the many already made as to the ratio of these two masses. Fürth[6] has obtained a remarkable relation involving the constant of gravitation, G, and the mass of the 'neutron' which he regards as formed by the combination of a positive and negative electron. Assuming this mass to be the same as that of the hydrogen atom, M_H, his relation may be written in the simplified form $2bc/GM_H^2 = (16)^{32}$ where $b = h/2\pi$. This gives good agreement with experimental results.

The power of 16 which occurs in Fürth's relation is introduced in considering the number of arrangements in a 16-dimensional continuum as in Eddington's theory, which requires 16 parameters for the complete determination of an electron. For an electron Fürth finds a total of 16^{16} possible arrangements and for a 'neutron' 16^{32} distinct possibilities. His formula suggested to me that the ratio of the masses of proton and electron might be of the form

$$\frac{M_P}{m_e} = \left(\frac{16}{10}\right)^{16} = 1844{\cdot}68.$$

Here again, the number 16 represents the number of parameters or 'degrees of freedom' which, according to Proca,[7] are characteristic of an electron. These Proca classifies as 4 co-ordinates, 4 moments, 3 components of magnetic moment, 3 components of electric moment, the mass, and the de Broglie wavelength. The presence of the integer 10 in the above relation may be explained by assuming that, of the 16 degrees of freedom associated with an electron, 6 are suppressed or 'frozen' in the case of the positive electron. It is natural to suppose that these are the three components of the electric moment and the three components of the magnetic moment, all of which are here regarded as having some real physical meaning for the negative electron. Perhaps the proton, as contrasted with the negative electron, is simply 'a hole in the ether' without electric or magnetic moment. This hypothesis reverses the rôles assigned to these two entities in 1913 by S. B. McLaren, who assumed that the positive electron was the magneton.

It is with some hesitation that I put forward this tentative suggestion, partly because the theory of

Fürth seems to be based on somewhat uncertain assumptions, and also because the value suggested for the ratio of the masses is not in exact agreement with either the 'deflection' or the 'spectroscopic' values.

H. S. ALLEN.

The University, St. Andrews,
April 11.

[1] W. N. Bond, NATURE, **127**, p. 164 and p. 557; 1931.
[2] Birge, *Phys. Rev.*, Supplement, vol. 1, No. 1, pp. 1-73; 1929.
[3] Rojansky, NATURE, **123**, p. 911; 1929.
[4] Eddington, NATURE, **126**, p. 942; 1930.
[5] Witmer, NATURE. **124**, p. 180; 1929.
[6] Fürth, *Phys. Zeitsch.*, vol. 30, p. 895; 1929.
[7] Proca, *Journal de Physique*, p. 235, July 1930.

Low Altitude Aurora.

MR. AXEL CORLIN [1] has described an observation which has convinced him that the aurora can appear under the clouds. I have also observed a similar phenomenon; but in circumstances which made it possible for me to convince myself that the whole effect was an illusion and that the aurora was above and not below the clouds.

In my opinion it would be unfortunate if Mr. Corlin's account should be accepted as good evidence that an aurora can appear "only a few thousand metres above the ground", especially in view of Prof. Chapman's important article [2] in which he practically accepts the evidence for low auroræ.

The essentials of Mr. Corlin's account are as follows:

"In the afternoon of Nov. 16, 1929, during my stay in Abisko in northern Sweden (N. lat. 68° 21′) I observed a rather intensive auroral ray of about 10° apparent length and about ½° apparent breadth in the west-south-west *below a completely cloudy sky*."

"The clouds, apparently situated behind the ray, were of stratiform alto-cumulus type and consisted of apparently thin and thick strata. The ray began in or in front of a thin stratum, crossed over a thick (more dark) stratum *without appearing less intense here*, and vanished in or in front of the next thin stratum. In the east, similar clouds covered almost completely the sky and *also the full moon*, which was visible only a few times between the clouds. Examining carefully the facts mentioned above in italics, I could not escape the conclusion that the auroral ray must be *below the clouds*, that is, at only a few thousand metres above the ground."

My experience is recorded in a paper, "Atmospheric Electricity in High Latitudes",[3] which describes observations made at Karasjok, Norway (69° 17′ N., 25° 35′ E.), during twelve months, October 1903–September 1904. I wrote, p. 92:

"It has long been a matter of controversy as to whether the aurora ever extends into the lower regions of the atmosphere. Several observers positively affirm that they have seen it quite close to the ground. This may be due to an optical illusion; one evening I was, for a considerable time, in doubt as to whether the aurora was really under the clouds or not. All over the sky were detached clouds, the clouds and spaces between them being of about the same size and shape. Right across the sky a long narrow aurora beam stretched, showing bright and dark patches owing to the clouds. It looked exactly as if the aurora beam ran along under the clouds, brightly illuminating the patches of cloud which it met. In reality the bright patches were the openings and not the clouds. It took me a long time to make quite certain of this, and it was only by at last seeing a star in the middle of a bright patch that I could be quite certain."

It is clear that these two experiences were practically identical, and there can be little doubt that what Mr. Corlin considered to be thicker parts in the cloud covering were really breaks in the cloud through which the dark sky could be seen. In his case the illusion was probably enhanced by the clouds near the moon showing dark centres.

Although it is now twenty-seven years since I made my observations, I clearly recollect the difficulty I had in deciding what was cloud and what was clear sky. The illusion was most convincing, and if I had not been able to see the stars in the patches which appeared to me to be illuminated cloud, I should have come to the same conclusion as Mr. Corlin.

G. C. SIMPSON.

Meteorological Office, London,
April 15.

[1] NATURE, April 11, p. 553.
[2] NATURE, Mar. 7, p. 341.
[3] *Phil. Trans. Roy. Soc.*, A, vol. 205, pp. 61-97; 1905.

The Molecular Weights of Proteins.

ONE of the most satisfactory features of recent advances in the X-ray analysis of compounds of high molecular weight has been the degree of co-ordination between the efforts of the structure analyst and those of the chemist. Especially is this true in the case of investigations of the structure of cellulose and its derivatives. The question of protein structure, however, appears to bring in its train problems of quite another order of complexity, and it does not seem to be at all clear what is connoted by the phrase 'molecular weights of proteins'. Such X-ray photographs of fibrous proteins as have been obtained point to the periodic repetition of comparatively simple units with imperfect or variable side-linkages. In the quest for chemical data to correlate with these results, the crystallographer is at once brought up against the remarkable observations of Svedberg, that there are groups of soluble proteins of 'molecular weights' which are simple multiples of 34,500. The present situation is most simply described by quotations from two recent letters [1,2] to NATURE:—

1. "The two most striking demonstrations in recent years of such uniformity are afforded by Svedberg's brilliant application of the ultracentrifuge to determine the particle mass of soluble proteins, classes of 'molecular weight' 1, 2, 3, and 6 times the common factor 34,500 being distinguished, and Gorter and Grendel's demonstration that under appropriate conditions soluble proteins exhibit the phenomenon of surface spreading on liquids, and that all occupy the same surface area irrespective of particle mass (1, 2, 3, or 6 times 34,500). Using Svedberg's common factor 34,500 for the basis of their calculations, the Dutch workers obtain a value for the radius of the unit particle (22·5 A.) identical with that determined by Svedberg experimentally."

2. "Three determinations of the sedimentation equilibrium of insulin at a *p*H of 6·7–6·8 gave as a mean value for the molecular weight 35,100, which within the limits of experimental error is the same as that for egg albumin, 34,500, and for Bence Jones protein, 35,000. . . . The sedimentation equilibrium determinations show that crystalline insulin is homogeneous with regard to molecular weight, that is, the molecules in the sample studied were all of the same weight."

If now we consider this problem from the purely crystallographic point of view—and it has been demonstrated that proteins under certain conditions can give rise to X-ray crystal photographs—the numbers 1, 2, 3, and 6 immediately invite attention as being possible numbers of 'molecules' which can go to form a unit of pattern. The suggestion thus

arises that, provided we can explain the occurrence of the weight 34,500, the rest may be merely another aspect of that grouping of molecules which is called crystalline. But if this is so, we have to account for the non-occurrence of the number 4, and the explanation of this gap must be given in terms of some outstanding characteristic of proteins in general.

In order to explain the sequence of numbers observed, it does not seem necessary to invoke anything more unfamiliar than the ordinary peptide chain, -CO-NH-CHR-CO-NH-CHR-, which is built up of a succession of triads of which the -CO- and -NH- groups are unsaturated; for if we postulate that the -CO- and -NH- groups of neighbouring chains can be linked together by secondary valences, the following simple crystallographic combinations [3] are at once available (Figs. 1*a*, 1*b*, 1*c*, 1*d*).

In Fig. 1*b*, corresponding to the crystallographic space-group C_2^1, the unit of pattern is a pair of chains pointing in opposite directions, while the basis of Fig. 1*c*, space-group C_3^2, is a self-contained threefold screw of chains all pointing in the same direction. In Fig. 1*d* one of the chains has been omitted to avoid confusion, but it will be seen that it is a grouping

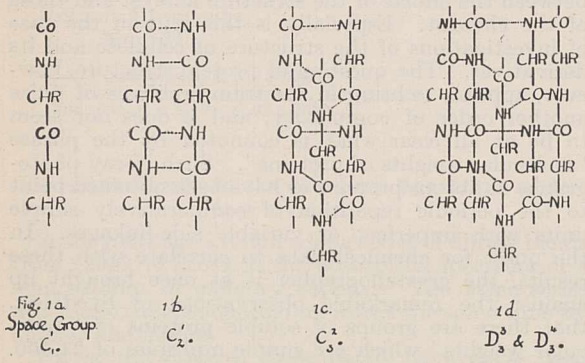

FIG. 1.

which is a combination of (*b*) and (*c*) based on the space-groups D_3^3 and D_3^4, and is also a self-contained threefold screw, but this time not of single chains, but of pairs of chains such as are shown in Fig. 1*b*. All these molecular associations are well-defined crystallographic types—the arrangement shown in Fig. 1*d*, for example, corresponds to the structure of such a common crystal as quartz—which might be expected to undergo reversible dissociation into their constituent units, or sub-groups. That such a process actually does take place is best illustrated by the words [4] of Svedberg himself:—"The protein molecules containing more than one group of weight 34,500 are, as a rule, dissociated into molecules of lower numbers of groups of 34,500 when the *p*H of the solution is raised over a certain value. Thus the proteins of weight (6 × 34,500) split up into molecules of 1/2, 1/3, and 1/6 of the original molecule, but never into molecules of 1/4 or 1/5 of the original. This is in line with the fact that proteins possessing these latter weights at or near their isoelectric point have not been met with. At sufficiently high alkalinity all proteins have the same molecular weight, viz., 34,500."

The problem embodied in the last sentence still remains for discussion, and we should like to suggest as the interpretation of this, the most fundamental difficulty of all, that the observed constancy of unit molecular weight is simply a case of the vibrational instability of peptide chains when their length exceeds a certain value. If we accept the X-ray indications that the fibrous proteins, such as hair [5] and silk,[6] are based on the periodic repetition of comparatively simple units, then the probability of disruptive resonance occuring among the constituents of the peptide chain will continually increase with the length, so that excessively long chains would be liable to spontaneous decomposition into shorter chains. We may imagine some such process taking place in the laboratory of the living cell as the amino-acids are laid down in long chains at a surface and consolidated by crystallographic groupings in the manner suggested above, or by intra-molecular folding such as has been demonstrated in the case of wool and hair.[5] From this point of view, it does not seem likely that the unit molecular weight of proteins is strictly constant—this, too, is in agreement with experiment—but there is a strong probability that, given the appropriate conditions, many proteins will be based on a roughly constant weight of peptide chain.*

A phenomenon which appears to involve analogous reasoning is the decay of tension at constant length which takes place in stretched hair containing moisture, and which has been investigated by Speakman.[7] A large part of this loss of tension is quite permanent,[8] in spite of the fact that the stretched hair still retains its power of recovering at least its original length in water. The rate of decay of tension varies with the type of wool or hair and with the nature of the wetting agent, and increases with rise of temperature. It is extremely rapid in steam, a short treatment with which permanently alters the load/extension curve, and so loosens the internal structure of the fibre that it may be caused to contract to two-thirds of its original length.[5]

It is clear, of course, that the wetting agent plays an important part in this permanent destruction of internal tension, but it seems not at all unlikely that vibrational instability also is an essential factor in the process. After treatment of stretched hair with steam, the longitudinal swelling of the fibre in water is considerably increased, a fact which, taken in conjunction with the observation that X-ray photographs of hair which has been held stretched in water for several weeks show a definite fuzziness of the reflections associated with the length of the peptide chains, suggests that the average length of the chains is decreased by sustained tension in the presence of water.

We have recently commenced an investigation of the influence of radiations, such as ultra-violet light and X-rays, on the elastic and other properties of animal hairs, so that in this connexion it is convenient to mention here some remarkable observations which we have made on *unstretched* wool exposed for some sixty hours to the full beam of a Shearer X-ray tube (copper anticathode). After this treatment the fibres show many of the properties which are characteristic of wool which has been exposed *in the stretched state* to the action of steam. For example, they have the property of contracting in steam by as much as 37 per cent below their unstretched length, and their longitudinal swelling in water after steaming is found to be increased from the 1 per cent of normal wool to as much as 10 per cent. This seems to be a clear case of the disruptive action of high-energy quanta on the length and cohesion of peptide chains, and must be closely related to the influence of various radiations on biological activity.

* If we assume the essential correctness of the structure proposed,[5] we may make an estimate of the length of peptide chain in animal hairs. The average molecular weight of the chief amino-acids in wool (which are present in roughly equal molecular proportions) is about 121, and three amino-acids occupy a length of 5·15 A. along the fibre axis. The length, corresponding to 34,500, is thus about 500 A. It is a striking fact that this is approximately the length which is the minimum possible to give the observed X-ray diffraction effects.[9] That it is also near the actual length is indicated by the fuzziness which appears in X-ray photographs of hairs which have developed pronounced permanent decay of tension.

These experiments are being continued and will be reported in detail in due course.

W. T. ASTBURY.
H. J. WOODS.

Textile Physics Laboratory,
University, Leeds,
Mar. 27.

[1] C. Rimington, NATURE, **127**, 440; 1931.
[2] T. Svedberg, NATURE, **127**, 438; 1931.
[3] W. T. Astbury and K. Yardley, *Phil. Trans. Roy. Soc.*, A, **224**, 221; 1924. (See Plate 5 (1), (7), Plate 16 (144), Plate 18 (157 and 158).)
[4] T. Svedberg, *Trans. Faraday Soc.*, "General Discussion on Colloid Science applied to Biology", 741; 1930.
[5] W. T. Astbury, *J. Soc. Chem. Ind.*, **49**, 441; 1930: *J. Textile Science*, **4**, 1; 1931. W. T. Astbury and H. J. Woods, NATURE, **126**, 913; 1930. W. T. Astbury and A. Street, *Phil. Trans. Roy. Soc.*, A, **230**, 75; 1931.
[6] R. Brill, *Ann. Chem.*, **434**, 204; 1923. K. H. Meyer and H. Mark, *Ber.*, **61**, 1932; 1928. O. Kratky, *Z. phys. Chem.*, B5, 297; 1929.
[7] J. B. Speakman, *Proc. Roy. Soc.*, B, **103**, 377; 1928.
[8] J. B. Speakman, *Trans. Farad. Soc.*, **25**, 169; 1929.
[9] J. Hengstenberg and H. Mark, *Zeit. f. Krist.*, **69**, 271; 1928.

The *p*H Stability Region of Insoluble Proteins.

BY means of the ultracentrifugal method developed in his laboratory, Svedberg [1] has measured the stability of a number of soluble proteins as a function of the *p*H of the environment. Each of the monodisperse proteins was found to have a fairly wide *p*H-stability region which included the isoelectric point. By means of a totally different technique, we have recently been able to show that insoluble proteins, such as wool keratin, are no exception to the above

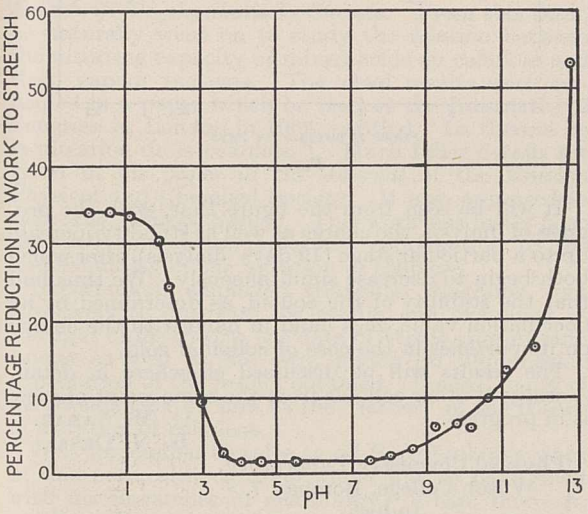

FIG. 1.

rule. The method, which we believe to have a general application, took its origin in the observation that the resistance of wool fibres to extension is far less in acid solution than in distilled water. This, and the well-known ease of extension of fibres in alkaline solution, give a method for studying the stability of the keratin in various media.

Briefly, the experimental procedure was as follows: the work required to stretch fibres 30 per cent of their length was determined at 22·2° C., first in water at a standard *p*H of about 5·5 and then in the medium under examination, twenty-four hours being allowed in each case for the fibres to attain equilibrium. Extension was limited to 30 per cent because it has been shown that wool fibres can be extended this amount in distilled water without undergoing significant damage. Thus, any difference between the two values for the work required to perform this extension is directly attributable to the different actions of the two media, and it is convenient to express this difference as a percentage of the work required to stretch a fibre 30 per cent of its length in water at the standard *p*H.

The results shown in Fig. 1 were obtained with sulphuric acid solutions on the acid side of the isoelectric point, and with borax, sodium carbonate, and caustic soda solutions on the alkaline side. It is clear that wool keratin is completely stable over a range of *p*H from 4 to at least 7. The isoelectric point of wool, as determined by one of us [2] in 1925, is at *p*H 4·8, and it is interesting to recall that Svedberg [3] states that, for the proteins he examined, the isoelectric point "is never situated in the middle of the stability region but is always more or less shifted in the direction of low *p*H values".

The similarity between wool keratin and the proteins studied by Svedberg is not confined to the existence of a stability region and the location of the isoelectric point, but is much more fundamental in character. For example, he states that the decomposition of a protein in solutions at a *p*H outside the stability region is in many cases reversible; that is, if the mixture is restored to a *p*H situated within the stability region, molecules of the original weight are built out of the fragments. Similarly, it has long been known [4] in the case of the wool fibre that the action of $N/100$ sodium carbonate is reversed by the mere removal of the reagent by washing in water. More recently, the action of acids on wool has also been found to be reversible. For example, wool fibres in 4·8 N hydrochloric acid required 39 per cent less work to perform a given extension than in water, but, on washing the fibres free from acid, the resistance to extension reverted almost completely to its original value in water.

The complete parallel which thus exists between wool keratin and the proteins studied by Svedberg is important because of certain peculiarities in the action of acids on wool, which have a bearing on his conclusion that the proteins forming one of the two groups defined by him have molecular weights 1, 2, 3, and 6 times 34,500. The action of 98-100 per cent formic acid on wool is instructive. In this medium, dry fibres give a load-extension curve which is exponential in its initial stages, in contradistinction to the normal curve for wool fibres in water, which shows a well-defined Hooke's law region up to a stress of 4×10^5 gm./cm.^{2}. Silk filaments in formic acid fail to give an X-ray fibre diagram,[5] and a similar observation may be presumed true for wool, suggesting that the long-chain protein molecules are freed from their mutual attractions to a very great extent in this reagent. Thus the exponential type of load-extension curve given by fibres in formic acid would be attributed to the free uncoiling of the molecules in the manner suggested by Astbury,[6] and calculation from the curve shows that the limiting extension to be expected by this process is 28·4 per cent, in close agreement with the value previously deduced [4] from the load-extension curve for wool fibres in water and that found by Astbury [6] from X-ray studies of stretched wool (about 30 per cent).

Such close agreement can leave little doubt that in formic acid the individual long-chain protein molecules of the micelles are greatly freed from their mutual attractions. Since the action of both organic and inorganic acids is to reduce the resistance of fibres to extension, it may be presumed that in all cases their essential function is to free the molecules in this way. On this view, however, all acids would be expected to show precisely the same behaviour at comparable concentrations and it is here that difficulty is encountered. As shown in Fig. 1, the resistance of wool fibres to extension in $N/10$ sulphuric acid solution is 33 per cent less than in water, and since the

corresponding value for 11 *N* sulphuric acid solution is only 39 per cent (including true chemical damage), it is clear that the truly reversible action of sulphuric acid on wool is complete at about *N*/10 concentration. The behaviour of hydrochloric acid is strictly comparable with that of sulphuric acid, but formic acid, on the other hand, gives a reduction in the resistance to extension of about 60 per cent, its action being still almost completely reversible. Similarly, the swelling of wool fibres in formic acid is of a different order of magnitude from that in sulphuric acid solutions. Thus, although the action of these and other acids is of the same general type, gross differences in the extent of reaction exist.

It is here that support is given to, and an explanation of the phenomenon derived from, the theory developed by Astbury in the preceding letter. If the wool molecule should exist in the condition of a self-contained threefold screw of pairs of chains, it is clear that the simplification of this condition can occur in several ways : either by the formation of the crystallographic sub-groups—three pairs of chains or two triads of simple chains—or by the formation of individual molecular chains. On this view, the different reactivities of formic and sulphuric acids with wool would be attributed to the ability of formic acid to carry the simplification of the structure to the stage of individual chain formation, while with other acids simplification must cease at one or other of the intermediate stages. If this hypothesis is true, it is clear that the adsorption of acid by wool will be accompanied by the creation of new surfaces available for adsorption, the nature and extent of these surfaces being determined by the nature of the acid adsorbed. On this basis, a convincing explanation of the many anomalies in the adsorption of various acids by wool can be given. Indeed, most of the phenomena observed in connexion with the action of acids on wool are difficult of explanation except on some such basis as that given above.

J. B. SPEAKMAN.
MERCIA C. HIRST.

Textile Chemistry Laboratory,
University, Leeds,
Mar. 26.

[1] Svedberg, "General Discussion on Colloid Science applied to Biology". *Trans. Faraday Soc.*, p. 740 ; 1930.
[2] Speakman, *J. Soc. Dyers and Colourists*, **25**, 172 ; 1925.
[3] Svedberg, loc. cit., p. 741.
[4] Speakman, *Proc. Roy. Soc.*, **103**, B, 389 ; 1928.
[5] Meyer and Mark, "Der Aufbau der Hochpolymeren Organischen Naturstoffe". Leipzig, 1930, p. 224.
[6] Astbury, *Phil. Trans.*, **230**, A, 75 ; 1931.

Relation between Charge and Stability of Colloidal Gold.

IT is believed by most colloid chemists that the stability of a colloid depends on the charge on its particles, and that the greater the charge the greater the stability. The results of coagulation of colloids by electrolytes, as well as the effect of dialysis on the stability of the colloid, have been explained on the basis of the above idea. Mukherjee and collaborators,[1] however, working on arsenious sulphide sol, found that the stability of this sol is not so directly related to the charge as it is generally believed to be.

It is well known that the charge on colloidal gold and its stability towards electrolytes increase with the progress of dialysis up to a certain stage, after which both charge and stability begin to decrease.[2] Simultaneous measurements of charge and stability towards electrolytes with the progress of dialysis have been carried out by us to see if there is any definite relationship between charge and stability of colloidal gold.

The gold sol was prepared by Zsigmondy's nucleus method, with slight modifications in details. The charge measurements were carried out by Mukherjee's method (loc. cit.), and the stability towards electrolytes was determined by finding the amount of potassium chloride which would be required to produce a definite blue colour. The results are shown graphically in the accompanying graph (Fig. 1).

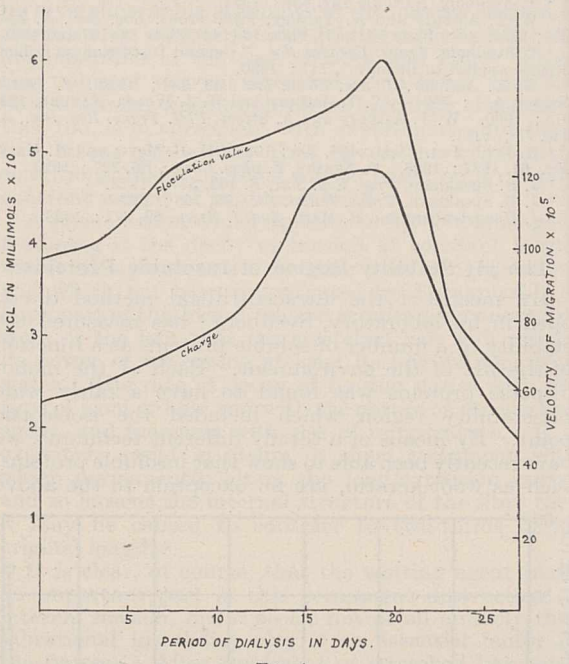

FIG. 1.

It will be seen from the figure that, with the progress of dialysis, the charge as well as stability increase up to a particular stage (19 days' dialysis), after which both begin to decrease simultaneously. We thus find that the stability of the colloid, as determined by its flocculation value, goes hand in hand with the charge on its particles in the case of colloidal gold.

The results will be discussed elsewhere in detail. A study of other colloids from the same point of view is in progress.

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[1] *Jour. Indian Chem. Soc.*, **4**, 493 ; 1927.
[2] Freundlich, "Colloid and Capillary Chemistry", 1926, English Translation, p. 506.

Prof. A. V. Saposhnikoff.

THE numerous friends of Prof. A. V. Saposhnikoff will learn with much regret of his arrest and exile (NATURE, April 25). I first came into touch with him during the International Congress of Applied Chemistry in London in 1909, and afterwards had the pleasure of working with him during the War and taking him over several of the explosives factories. The last time I saw him was in 1923, when he was in England on business for the Soviet Government. He is a charming man, and, under the new régime, was trying to serve his country to the best of his ability and to keep out of politics. It is now known that he was arrested on Oct. 1, but no charge against him has been made public. Knowing him as I do, I can only think that his arrest is the result of some dreadful mistake.

Prof. A. V. Saposhnikoff was born on Mar. 15, 1868,

in Siberia, and received his earlier education with the Corps of Cadets in Omsk and afterwards at the Michael Artillery School and Michael Ordnance Academy in Petrograd. He was appointed professor of chemistry at the Michael Ordnance Academy in 1899 and held that post up to his arrest. He also held other important posts and was widely consulted and received many honours and decorations, including that of Knight Commander of the Order of St. Michael and St. George from Great Britain

Saposhnikoff's work has been varied and is well known to scientific workers in Europe. Under the Soviet régime he has carried out much work in connexion with the use of petroleum on Russian railways, the danger of fire therefrom and means of fighting it, the impregnation of railway sleepers, etc. His outstanding researches, however, are on the chemistry of explosives and date from the beginning of the present century up to the War. He was not satisfied with the empirical knowledge of the nitration of cellulose and thought that a study of the physico-chemical conditions in the mixed acids used for nitration would throw some light on the question. He therefore measured the vapour tensions of mixtures of sulphuric acid, nitric acid, and water and showed the conditions under which all the water is attached to the sulphuric acid and the nitric acid left free, and also when further addition of sulphuric acid removed the water from the nitric acid, with formation of nitrogen pentoxide. These researches were published in the *Zeitschrift für physikalische Chemie*. From this work, he naturally went on to study the relation between the nitrating capacity of mixed acids on cellulose and their vapour tensions. The chief results were embodied in a paper which he read at the International Congress in London in 1909, entitled "La théorie de la nitration de la cellulose". Much fuller details are given in his paper in the *Journal* of the Russian Physical and Chemical Society. It also appeared in *Zeit. Ang. Schiess. Spreng.* This work has justly been regarded as a most important contribution to the understanding of the nitration of cellulose.

Saposhnikoff employed triangular diagrams very effectively to illustrate his results, and examined, in the light of his theory, the data of Vieille, Bruley, and Lunge as well as his own, giving an illuminating explanation of the results obtained. Indeed, many of his friends look on him as the 'father' of the theory of nitration of cellulose.

It is impossible to refer to all Saposhnikoff's work in this note, although one would like to have dealt with his researches in metallurgy. I can, however, emphatically endorse the statement made in NATURE that the loss which the world suffers through the banishment of such a brilliant scientific worker is disastrous.

WM. MACNAB.

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Phenomena in a Sounding Tube.

IN view of Prof. Andrade's recent communication on Kundt's tube effects,[1] the following observations may be of interest. The experiments were carried out in 1927 but have not yet been published. In our case supersonic sound waves were used, and the effects did not differ greatly, contrary to Prof. Andrade's suggestion, from those he obtains with waves of audio-frequency.

A piezoelectric system was used as a source of the supersonic waves, and powerful oscillations of the order of 1 cm. wave-length were radiated along the tube. The effects of these waves on magnesium oxide smoke were investigated. It may be noted at this point that the size of the average smoke particle in the first few seconds of an experiment was of the order of 5×10^{-5} cm. radius or less. Hence the individual particles would presumably take up the motion of the sound waves rather than act as obstacles like the dust particles in Prof. Andrade's experiments.

The first observation of interest was that if one end of the tube were open the smoke was pushed out rapidly. When, however, the ends were closed, the smoke was observed to circulate in a somewhat irregular manner. After a few seconds, large flocculent particles appeared and perfect rings formed on the sides of the glass tube, similar to those obtained with lycopodium in a Kundt's tube, except that they extended right round the tube, becoming a little thinner at the top.

The circulation of the smoke was examined more carefully by means of a parallel beam of light from an arc down the centre of the tube. At times a more or less turbulent motion occurred throughout the length of the tube; at others there appeared to be formed vortices at distances apart corresponding to the nodes, and at these points large flocculent particles were gradually built up owing to the rapid coagulation of the smoke. Some of these large flocks were in rapid rotation about an axis roughly corresponding with that of the tube. They remained suspended in the middle of the tube at the nodes so long as the waves continued. If the waves were stopped, the flocks rapidly settled after a minute or so, and the tube was found to be practically clear of smoke, nothing but well-marked rings remaining.

H. S. PATTERSON.
W. CAWOOD.

The University, Leeds,
Mar. 23.

[1] NATURE, Mar. 21, p. 438.

The Nature of Time.

IN NATURE of Jan. 31, p. 163, F. O. Wollaston and K. W. Miller suggest that time consists of discrete sections: that is, time has an interrupted structure. The element of time is assumed to be equal to h/mc^2, where m is the mass of the electron. In connexion with this subject, it should be noted that a similar idea was put forward by Robert Lévy,[1] and was afterwards worked out more closely by myself,[2] Gottfried Beck,[3] Wilhelm Anderson,[4] and Seitarô Sùzuki.[5] In this way it was possible to establish a range of regularities bearing upon astrophysics and the nature of cosmic rays.[6] These regularities also correspond well with Dirac's[7] theory of protons and electrons. In all these cases, however, it is necessary to take a smaller element of time than that shown above. This elementary interval is equal to h/Mc^2, where M is the mass of the proton.

G. I. POKROWSKI.

Allunion Electrotechnical Institute,
Moscow 33, Mar. 24.

[1] Robert Lévy, *C.R.*, **183**, 1026; 1926.
[2] G. I. Pokrowski, *Zeitschr. f Phys.*, **51**, 730, 737; 1928.
[3] Gottfried Beck, *Zeitschr. f. Phys.*, **53**, 675; 1929.
[4] Wilhelm Anderson, *Zeitschr. f. Phys.*, **55**, 386; 1929.
[5] Seitarô Sùzuki, *Phys. Zeitschr.*, **31**, 619; 1930.
[6] E. Regener, *Naturwiss.*, **17**, 183; 1929.
[7] G. T. Pokrowski, *Zeitschr. f. Phys.*, **66**, 129; 1930.

Magnetic Hysteresis on Weber's Theory: A Correction.

I REGRET a slight oversight in my letter published in NATURE of April 25, p. 625. For "*OM*" should be read "*ON*, where *N* is the foot of the perpendicular, Fig. 1, from the intersection of *OC* and the unit circle".

W. PEDDIE.

Dundee.

Ozone in the Upper Atmosphere and its Relation to Meteorology.*

By Dr. G. M. B. DOBSON, F.R.S.

UNTIL nearly the close of the nineteenth century, meteorologists — with but a few exceptions—had been content to confine their attention to studying the atmosphere near the ground. When Teisserenc de Bort and W. H. Dines began to study the conditions up to a height of 20 km. or more by means of small balloons carrying light self-recording instruments, it immediately became clear that a knowledge of the free atmosphere is essential to an understanding of the physical processes which we include in the term meteorology. Since, however, observations have shown that while pressure gradients associated with cyclones or anticyclones, after continuing without great change throughout the troposphere in most cases, fall off rapidly within the stratosphere, and become very small at about 20 km., we have come to regard the domain of physical meteorology as being roughly confined to that part of the atmosphere below about 20 km. I wish now to describe some observations that seem to show that there are effects of cyclones and anticyclones which extend up to something like three times that height.

About ten years ago, MM. Fabry and Buisson first showed that there is a very small amount of ozone situated at a great height in the atmosphere, and they also developed methods by which the amount could be measured with considerable accuracy. The actual amount is very small, but, as will be shown, it has very important effects. If the various gases of the atmosphere were all separated from each other and brought to a layer uniform in density at normal temperature and pressure, the thicknesses of the layers of different gases would be as given below :

Gas.	Nitrogen.	Oxygen.	Argon.	Carbon dioxide.	Neon.	Helium.	Ozone.
Thickness	6·2 km.	1·7 km.	76 m.	2·4 m.	10 cm.	3·2 cm.	3 mm.

This shows how very little ozone there is compared with the other gases, but the effect of even this small amount is by no means unimportant ; thus, it prevents excessively strong ultra-violet radiation from the sun, which would cause intense sunburn and other effects, from reaching the earth, and it is further responsible for raising the temperature of the atmosphere at great heights to values far above those of the stratosphere and probably nearly up to the normal boiling-point of water.

Turning now to the methods used for measuring the amount of ozone in the atmosphere, this is always done by spectroscopic means. Ozone has an exceedingly strong absorption band in the ultra-violet region between about 3200 A. and 2200 A., so that if we measure the absorption of light of a suitable wave-length while passing through the atmosphere, we can deduce the amount of ozone through which the light has passed. In practice it is not convenient to measure the absolute intensity of one wave-length, but we measure the ratio of the intensities of two adjacent wave-lengths, chosen so that one is strongly absorbed by ozone while the other is but little absorbed. By this means we largely eliminate changes due to haziness in the lower atmosphere and also changes in the energy emitted by the sun.

For most of the work so far accomplished, photographic instruments have been used, and spectrograms of sunlight are taken under carefully controlled conditions so that the energies in the different wave-lengths can be accurately determined. With these instruments there is naturally a most inconvenient delay due to developing and measuring the plates before the ozone content can be deduced ; further, the labour is very great. Photoelectric methods are now available which allow exceedingly small amounts of light to be measured, and these, when used in conjunction with a suitable double spectroscope, allow the ozone to be easily measured within a total time of about five minutes at all times when the sun is more than about 10° above the horizon, whether the sky be cloudy or not. If the sky be clear, measurements can be made even when the sun is much nearer the horizon. Indeed, we may say that, provided the sun is sufficiently above the horizon, we can measure the amount of ozone in the upper atmosphere nearly as easily as we can measure the barometric pressure and with an accuracy approaching that of barometric readings, when we take into account the ' correction to sea-level ' to be applied when comparing barometer readings at different places, which is often rather uncertain for stations at some little height above sea-level.

The height of the ozone in the atmosphere can be deduced by taking measurements when the sun is rising or setting, since in these conditions the calculation of the amount of ozone involves both the height of the ozone and the curvature of the earth. The method is not very accurate, but a large number of measurements show that the average height of the ozone layer is about 50 km. above sea-level. We do not yet know how far above or below this height the ozone layer extends.

When measurements of the quantity of ozone are made in temperate latitudes, it is found that there are large variations in the amount present from day to day, amounting to nearly 50 per cent of the mean value. There is also found to be a well-marked annual variation, having a maximum in spring and minimum in autumn. The day-to-day variations show a close connexion with the meteorological conditions in the upper troposphere and lower stratosphere, the amount of ozone being high when the temperature of the troposphere is low, when the pressure near the base of the stratosphere is low, and when the height of the base of the stratosphere is low, and vice versa. The number of meteorological observations reaching a height of more than 15 km. is not very large, but such observations as there are indicate that the amount of ozone is closely related to the pressure up to the

* Friday evening discourse delivered at the Royal Institution on Mar. 6.

greatest height where observations are available. It has also been shown by Dr. Duckert that the amount of ozone is closely related to the density of the air about 15 km. and above, but not with that at a lower level. Considering that the comparison has necessarily to be made between ozone measurements made at one place and meteorological observations made 100 km. or more away and often some hours different in time, it is remarkable that correlation coefficients so high as 0·80 have been found.

When the distribution of ozone is compared with the distribution of barometric pressure, a close relationship is again found. Unfortunately, the meteorological observations are not available from which maps showing the distribution of pressure and temperature at various heights in the atmosphere can be drawn, but even the surface distribution shows that the two are closely associated. Observations were made at seven places in north-west Europe in order to study this relationship during 1926 and 1927, and the distribution of ozone in the different regions of a typical cyclone or anticyclone are shown in Figs. 1 and 2.* At the time when these measurements were made, only the older photographic spectrographs were available, and these could not be used when the sun was low or when the sky was cloudy, so that measurements had to be stopped during the winter, and even in the summer a large number of days were missed owing to cloudy skies. Thus the information at present available is very meagre, but there is no doubt whatever that in practically all cyclones the distribution of ozone is roughly as indicated in the accompanying figures, and there are indications that cyclones only form when there are large differences of ozone in adjacent regions. It was seen that the relation between the amount of ozone and the meteorological conditions at any one given place is very much closer if the conditions in the upper air are taken than if surface conditions are considered, and there is reason to think that if we were able to draw pressure and temperature maps for a height of, say, 10 km., we should find that the distribution of ozone

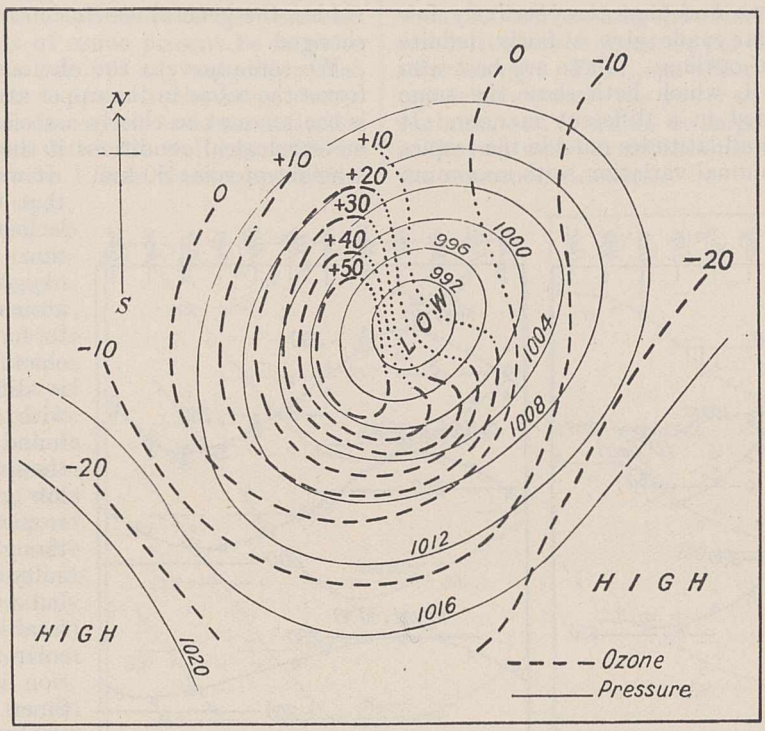

FIG. 1.

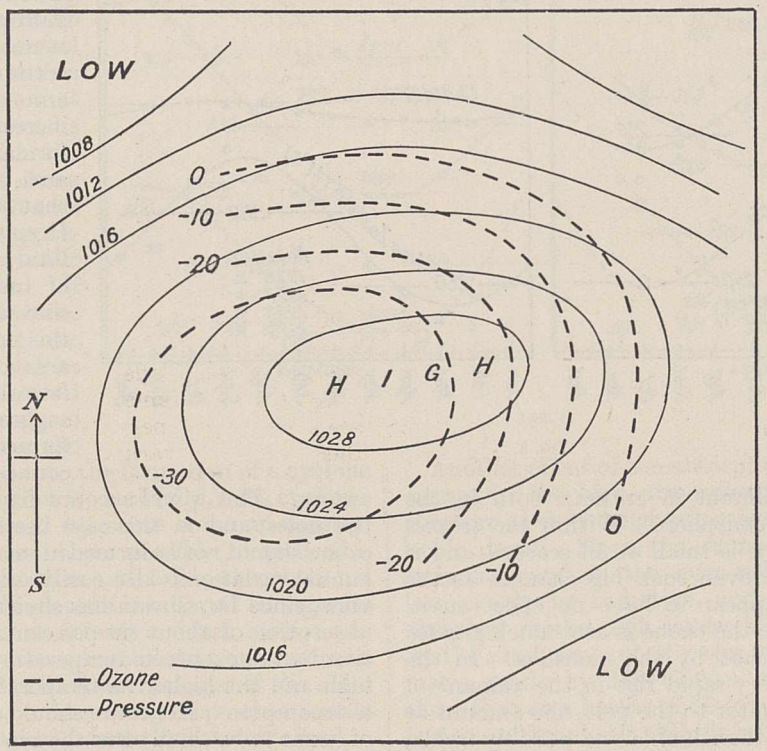

FIG. 2.

* The illustrations in this article are reproduced, by kind permission, from the *Proceedings of the Royal Society*.

showed an even closer connexion than that found using maps for the surface.

When we turn to the distribution of ozone over the whole world, we find that the relatively few measurements so far made give a fairly definite picture of the main outlines. These are best seen from Figs. 3 and 4, which both show the same results but presented in a different manner. It will be seen that at all latitudes outside the tropics there is a definite annual variation, with maximum in spring and minimum in autumn both in the north and south hemisphere. Within the tropics the amount of ozone is small at all seasons, and it is noteworthy that even such big changes as the Asiatic monsoon appear to have no effect on it, presumably because the ozone is at a much greater height than is reached by the monsoon. In the spring there is a very rapid rise in the amount of ozone from the equator to the pole, the amount at the pole being more than double, and possibly treble, that at the equator. On the other hand, in autumn there is but little change in the amount of ozone over the whole hemisphere. These results seem to be true for both north and south hemispheres, and though there have been only about one year's observations at most of the stations, it is thought that while another year may give slightly different values, the general conclusions are not likely to be changed.

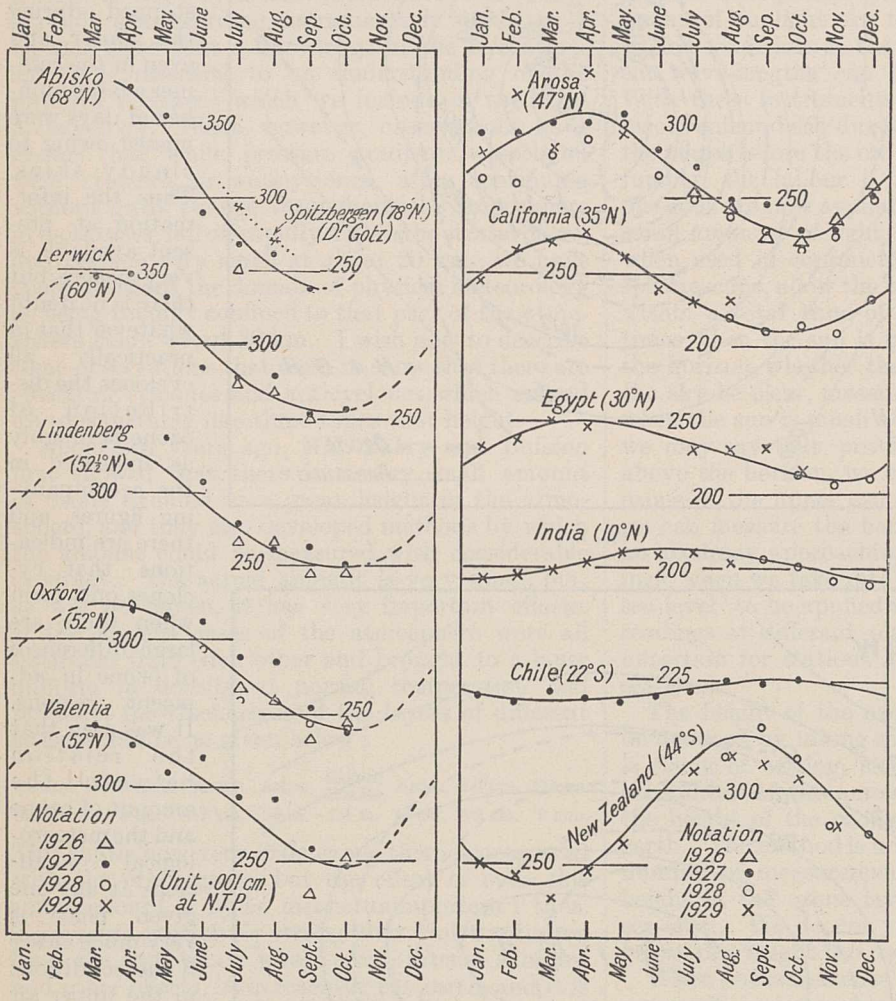

FIG. 3.

We come now to the obvious questions: What forms the ozone in the upper atmosphere, and why is the amount so closely associated with the other meteorological conditions if the ozone is really at a height of some 50 km.? It was at first supposed that the shorter wave-lengths of the sun's radiation, by breaking up oxygen molecules into atoms which combined to form ozone, was the chief cause. This view is difficult to reconcile with the high value found in polar regions in the spring and the steady low value within the tropics. It has been thought that this difficulty can be overcome, but we believe that it is fatal to the view that solar ultra-violet radiation is the chief cause. Since there have never yet been more than seven stations measuring the amount of ozone in Europe at one time, it is not possible to say for certain whether the amount of ozone is ever increased locally by formation over a limited area, but it is probable that this may happen. If so, it would be quite fatal to the hypothesis of ultra-violet light, since it would seem that this must affect a large area of the earth's surface alike. The only other suggestion is that it is formed by some action connected with the aurora. This would account for the high values at the poles, and in this case there is no reason why ozone should not be formed in small local areas. The annual variation is also easily accounted for on this view, since Dr. Gowan has shown that owing to the absorption of about six per cent of the sun's radiation by the ozone, its temperature will be relatively high and the higher its temperature the faster will it decompose. Hence we should expect the amount of ozone to be small after the sun has been strongest and large when the sun has been cut off, as at the poles at the end of the winter. There is, however, at present, no certainty in this matter.

The relation between the amount of ozone and

the meteorological conditions presents even greater difficulties. There are good reasons for thinking that the average height of the ozone layer is appreciably the same at all times of the year and whether the amount of ozone present be large or small. This seems to rule out any suggestion that in polar regions there is ozone in the lower stratosphere and that this is carried to lower latitudes by the polar currents which are well known to be associated with cyclones. Even if we suppose that the great polar and equatorial currents extend up to 50 km. and so transport ozone at this height, there are difficulties, for, as shown above, while there is a great difference between the amount of ozone at the pole and the equator in spring, there is but little difference in autumn, so that on this hypothesis the rear of cyclones should have much ozone in spring but there should be a nearly uniform distribution in autumn. This is far from being the case.

Again, so far as we can tell at present, the amount of ozone in the rear of a cyclone in Europe during the autumn seems to be greater than the normal amount anywhere within that hemisphere at that season. Thus, there is nowhere from which the ozone might have been transported, and we are almost driven to supposing that it is formed in the area where it is found. If this is so, there are three possibilities: either the presence of a cyclone causes ozone to be formed in the atmosphere above it, or a local increase in the amount of ozone leads to the formation of a cyclone in the atmosphere below it, or thirdly, both cyclones and ozone are formed by some common agency. At present it does not seem possible to settle this question without further and fuller observational material, and for this reason it is hoped to organise ozone observations at at least a dozen stations in Europe with the new photoelectric instruments, which have none of the disadvantages of the older photographic ones, and one may hope that results of great meteorological interest will be obtained.

In addition to the connexion between the amount of ozone and the meteorological conditions in the lower atmosphere, there are also other notable effects produced by it. Although the amount of ozone is so small, its absorption band in the ultra-violet region is so strong that it absorbs practically all the solar radiation of wave-length shorter than about 3000 A. reaching the outer atmosphere. Altogether, it absorbs about six per cent of the incoming solar energy. Thus, one effect of the ozone is to reduce enormously the power of the sun to produce sunburn, and it would be impossible to stay long in the sun without serious effects if it were not for the atmospheric ozone.

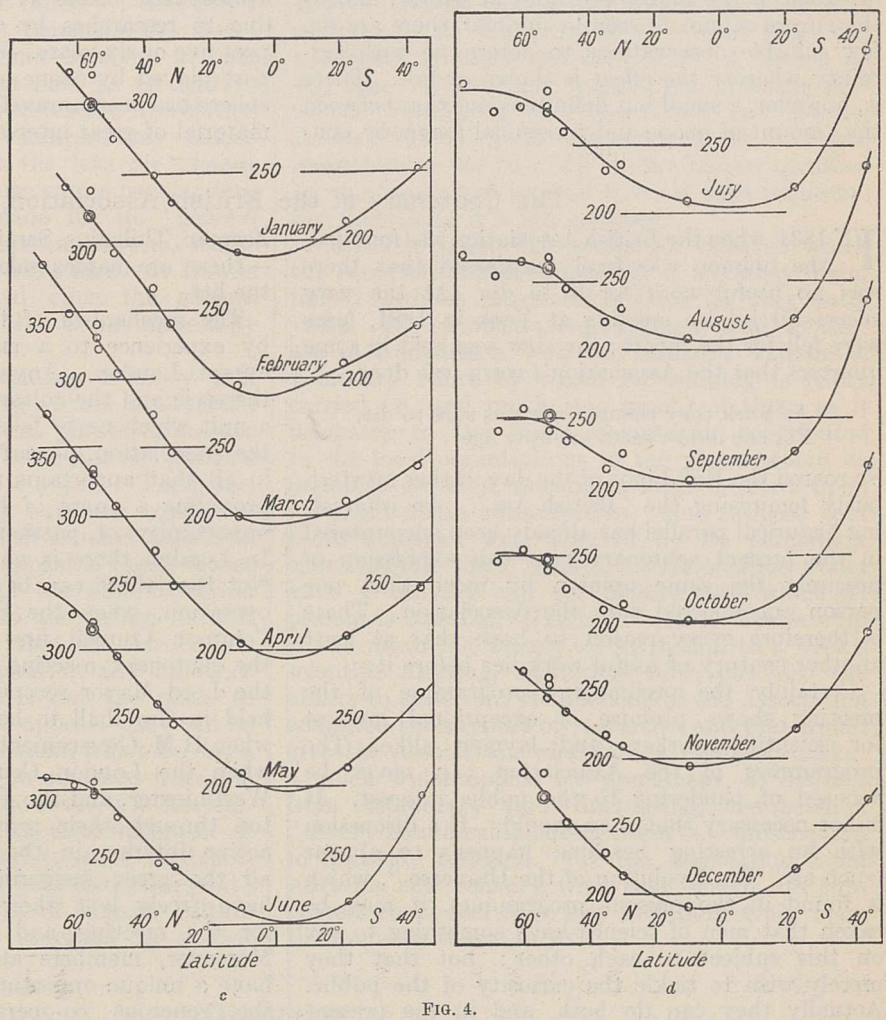

FIG. 4.

Another effect of the absorption of so much solar energy in the high atmosphere is that the temperature at these heights is raised much above that lower down. Since the ozone has only a weak emission band in the infra-red, it cannot easily lose energy by radiation, and most of the heat absorbed in the high layers is probably radiated by the small amount of water vapour there. Estimates made by Dr. Gowan of the temperature show that at a height of 50 km. a value of 400° A. is not unlikely. Dr. Whipple has shown that the high temperature at heights of about 50 km. is responsible for the abnormal audibility of sound from great explosions at distances of 200 km. or more from the source. Measurements made by

Dr. Whipple on the sound waves from artillery fire in Great Britain indicate temperatures up to nearly 400° A. at a height of some 45 km., agreeing well with Dr. Gowan's estimates.

If the ozone is formed by some action connected with the aurora, we should expect that the amount of ozone would show a connexion with the intensity of the visible aurora. Unfortunately, with the instruments which were used until recently, it was not possible to make measurements of the amount of ozone in the higher latitudes in winter, and as the aurora cannot be seen in summer, there are too few suitable observations to determine with certainty whether the effect is shown or not. There is, however, a small but definite connexion between the amount of ozone and terrestrial magnetic conditions, days of high magnetic character tending to have much ozone, and vice versa. This is what we should expect if the ozone were associated with the aurora. It is also significant that a large amount of ozone seems to be associated with magnetic disturbance but not with a large amplitude of the normal diurnal variation on magnetically quiet days, which we may suppose to be due to increased ionisation caused by ultra-violet radiation.

This is, briefly, the state of our knowledge of atmospheric ozone at the present time, which is due to researches by several workers during the past five or six years. When the whole story of the part played by ozone in the extreme upper atmosphere has been unravelled, it seems likely to afford material of great interest.

The Centenary of the British Association.

IN 1831, when the British Association was founded, the opinion was freely expressed that there was no useful work for it to do. At the very successful jubilee meeting at York in 1881, fears were felt for the future: the view was held in some quarters that the Association's work was done.

> "At York they thought she was sure to die,
> For she didn't seem to enjoy age . . ."

So roared the Red Lions of the day, rather mysteriously feminising the 'British Ass.'. An interesting historical parallel has already been encountered in the present centenary year—an expression of precisely the same opinion by more than one person unconnected with the Association. There is therefore every reason to hope that at least another century of useful work lies before it.

Certainly the preliminary programme of the meeting shows promise of exceptional interest for scientific workers and laymen alike. The programmes of the Association can never be accused of pandering to the public interest. It is not necessary that they should. If a discussion with an arresting headline happens to appear (such as "The Evolution of the Universe", which is found in the present programme), it may be taken that men of science have something to say on this subject to each other; not that they merely wish to tickle the curiosity of the public. Actually they can do both, and in the present year, what with the Faraday centenary immediately preceding, and the Clerk Maxwell celebration, and the jubilee of the Natural History Museum immediately following the Association's week, there ought to be a gathering of the 'cultivators of science' (to revive the phrase of 1831) such as has never been seen before, in Great Britain or elsewhere. The Association, at any rate, is doing what it can to give the occasion an imperial and, indeed, a world-wide significance by inviting representatives from all the places where it has met in the past, both at home and in the dominions, and also a notable list of foreign guests. Already there is a welcome response to these invitations. Fairfield Osborn, Gregory, and Cattell; Adamson, Torry, Kerr Grant, and McLennan; Ehrenfest, Zeeman, Thilenius, Sergi, Hevesy, Debye, Matschoss—these are names taken almost at hazard from the list.

The mechanism of the Association is adapted by experience to a meeting in any large town except London. Anywhere else than in London the civic and the cultural spirit of the place forms a unit which never fails to co-operate in receiving the Association, powerfully aiding its organisation in all that appertains to local arrangements, and providing a quota of local members to take the opportunity of participating in its transactions. In London there is no such unit: it is too big. Not that there can be suggested any lack of co-operation, when the City through its Court of Common Council first expressed the hope that the centenary meeting would be in London, and the Lord Mayor recently presided over a meeting held in Guildhall to hear the Association's aims; when H.M. Government has promised a reception; when the London County Council, the City of Westminster, and the Royal Borough of Kensington through their principal officers have shown active interest in the arrangements; and when all the great institutions in South Kensington have freely lent their splendid accommodation for the meeting and promised other facilities. Moreover, members attending the meeting will have a unique opportunity of visiting, again with the generous co-operation of the authorities concerned, a selection of the places of scientific interest in London at large, of which places the number is immense; and members will not fail to realise that this opportunity, so far as concerns the Association, will presumably not recur until 2031. Accepting these good gifts, but knowing that it has not on this occasion a local organising unit with which to deal, the Association has set itself to undertake a good deal of the 'local' side of the arrangements, and has backed its luck in respect of their cost. The unknown factor at present is the response of the London public to the stimulus of an Association meeting; the support by way of membership and financial contribution which may be looked for in London.

John Perry, the former general treasurer of the

Association, was wont to say that the centenary meeting must be held in London. He viewed the occasion with a treasurer's eye, hoping for a great membership and a substantial addition to the funds. Without doubt, also, he foresaw the need for a more adequate permanent endowment of the Association. The writer was present when Perry was told of Sir James Caird's gift of £10,000 to the Association at the Dundee meeting in 1912. "Very liberal", was his comment, in effect, "it should be an example to others"; and thereafter he was concerned to persuade the donor that the whole sum should not be spent at once (as was at first desired), but held as an endowment toward the researches which the Association helps with grants. The example was indeed followed in later years, by the late Sir Charles Parsons and Sir Alfred Yarrow, whose benefactions to the Association were made for its 'general purposes', and by Mr. Buckston Browne, whose gift and endowment of Darwin's house at Downe have already so far reacted upon the general purposes of the Association that it has materially enhanced its prestige.

The Association has undertaken a heavy task in trying to raise the Centenary Fund of £40,000; primarily because, in colloquial phrase, times are bad, and partly, perhaps, because it is not possible to set forth one big immediate object. There are, of course, the extraordinary expenses connected with the London meeting: will London take note of this? For the rest, the appeal is made rather because those responsible for the administration of the Association, looking to the future as well as viewing the past, know that the Association might better use its high position and influence if it had the means. This is not the place to discuss all the objects of the appeal—they can be learned from the official statement, which has been widely distributed and can be obtained from the office on request. In brief, however, the Association is, in a financial sense, an exacting guest of those places where it is invited to meet, an exacting taskmaster of those who voluntarily serve it: too much so. If any centre of human culture conceives that it would be benefited by a visit of the Association, it should in theory be possible for the Association to answer "Yes, we will come", instead of being compelled to ask the question, "Can you raise so much of a fund for our reception, and assure us of a sufficient membership?" This question is becoming the more pressing at the present time, because from more than one quarter of the overseas territories of the British Empire inquiries are reaching the Association whether there could be held in them, not a full annual meeting, but a congress of representative workers in all departments of science from the homeland, to meet the cultivators of science on the spot. This would introduce a principle new to the working of the Association, but how desirable! It is to be remembered also that the Association is the only body in the Empire qualified by the breadth of its field to meet such requests; but financially it is not qualified.

Consider, again, the grants for research which the Association has honourably if modestly maintained without intermission since its very early years. Its administrative expenses, small as they are in comparison with the immense volume of voluntary effort by which its working is really carried on, and much (too much) of them as it delegates to the funds voluntarily contributed to the local organisations in the places where its meetings are held, depend in large measure upon its membership subscriptions. But suppose that those expenses were covered by its permanent endowment. Then, indeed, the Association would have a rallying call for membership which at present is wanting. The invitation to membership would mean not merely an invitation to a week's scientific meeting, as it does now, but also the ability to state that membership of the Association connoted the support of research—and that would give the Association what it now definitely lacks: a much wider appeal for permanent, as distinct from temporary and fluctuating, membership. "Every membership subscription is a subscription to scientific research." If the Association could start its new century with that slogan, its supporters could feel that they had built truly upon the foundation laid in 1831.

Obituary.

Prof. W. C. M'Intosh, F.R.S.

THE death of Prof. W. C. M'Intosh at St. Andrews on April 1, at the patriarchal age of ninety-two, broke a link with the great naturalists of a long past epoch and closed a career pursued to the very end with single-minded devotion and an industry that seemed as if it could never flag. Only ten days before, he had come to London to preside at a meeting of the council of the Ray Society, but the long train journey back to St. Andrews in a bitter east wind proved too much even for his iron constitution.

William Carmichael M'Intosh was born at St. Andrews on Oct. 10, 1838. He was educated at Madras College and at the Universities of St. Andrews and Edinburgh, where he studied medicine. He received the degree of M.D. at Edinburgh in 1860, and was awarded a gold medal for his thesis, "Observations and Experiments on *Carcinus mœnas*". This essay, which he republished a few years ago, dealt mainly with the physiology of the nervous system in the shore-crab and its reactions to various drugs. He specialised in the study of mental disease and published several papers on the subject, becoming superintendent of the Perthshire Asylum at Murthly in 1863.

At Edinburgh, where he studied anatomy under John Goodsir, M'Intosh had published a paper on the arrangement of the muscular fibres in the heart of the bird, but another of his teachers, G. J. Allman, seems to have turned his attention more decisively towards marine zoology, a subject

that had attracted him since his boyhood on the shore at St. Andrews. He began early the long series of faunistic papers which were continued down to the last years of his life, on the marine invertebrates, chiefly of the North Sea, but with occasional excursions so far afield as the Outer Hebrides and the Channel Islands. A number of preliminary papers led up to his great monograph of the British marine annelids, published by the Ray Society, of which the first volume, dealing with the nemerteans, appeared in 1873–1874 and was at once recognised as marking a great advance in the knowledge of these animals.

The nemerteans are in some ways a peculiarly difficult group for anatomical study. Many of them are too large for examination of the whole animals to reveal much of their structure. Their pulpy consistency and the fact that the organs are embedded in a continuous parenchyma make dissection all but impossible, and the technique of section-cutting was then in its infancy. Later investigators, with vastly improved methods, have added much detail but have found surprisingly little to correct in M'Intosh's work. Dr. Otto Bürger, in his monograph of the Naples nemerteans, refers to "Die glänzende Monographie von M'Intosh" as having reduced to order the chaotic systematics of the group. Many years were to elapse before the continuation of the monograph, and the remaining volumes, dealing with the Polychæta, although of great and permanent value, had not the novelty and importance of the nemertean work.

Meanwhile M'Intosh had dealt with collections of polychætes from many parts of the world, the most important being that of the *Challenger* expedition, on which two stately volumes were published in 1885. In the course of his work on the *Challenger* material he received, for study, the specimens of the problematical organism which he named *Cephalodiscus*, which had been sent to various other specialists and returned by them as not belonging to the groups they were studying. M'Intosh gave a detailed description of *Cephalodiscus* and correctly recognised its affinity to *Rhabdopleura*, but it was Harmer who, in a postscript to M'Intosh's report, pointed out its relationship to the Chordata.

In 1882, M'Intosh was appointed to the chair of natural history in the University of St. Andrews, which he was to hold until 1917, and shortly afterwards he took up another line of work that engrossed his attention for many years. While at Murthly, he had published several papers on the life-history of the Tay salmon, and it was no doubt this that led to his selection to conduct investigations for the Royal Commission under Lord Dalhousie, which began in 1883 to inquire into the problems raised by the introduction of beam trawling and its effect upon the sea fisheries. Although by no means immune to the discomforts of work at sea, M'Intosh threw himself into the task with his wonted energy and enthusiasm. Perceiving the need for laboratory work on shore, he succeeded in establishing at St. Andrews the first marine laboratory in Great Britain. This was opened in 1884 in a small wooden building which had been hastily erected a few years before for use as a fever hospital. It is scarcely too much to say that for the next ten years this modest establishment was the headquarters of British marine research. The list of zoologists who worked there includes the names of Ray Lankester, Haeckel, Dohrn, Hubrecht, Nansen, Burdon Sanderson, Gotch, and many others of like distinction. When, in 1896, the wooden laboratory was replaced by the stone building provided by the generosity of Dr. C. H. Gatty, St. Andrews no longer stood alone, and the necessary support became increasingly hard to obtain. Since the War the Gatty Laboratory has stood shuttered and deserted.

It was in 1865 that the late Prof. G. O. Sars, of Norway, laid the foundation of scientific fishery research in a little paper in which he traced the life-history of the cod and showed that its eggs float on the surface of the sea. His work was followed up to some extent in the United States, but it was M'Intosh and his pupils who first showed that practically all our marine food-fishes, with the notable exception of the herring, have pelagic floating eggs, and by their detailed descriptions of the eggs and larval stages made possible the modern developments of fishery research.

At the time of his death M'Intosh was the senior fellow of the Linnean and several other scientific societies. From the Royal Society, to which he was elected in 1877, he received the Royal Medal in 1899, and the Linnean Society, of which he had been a fellow since 1863, awarded him its Linnean Medal in 1924. He was president of the Ray Society from 1913, and took an active part in its affairs up to a few days before his death.

M'Intosh was unmarried. Of his three sisters, one, who became the first wife of Dr. Albert Günther, was an accomplished artist, and her exquisite coloured drawings of marine animals adorn many of her brother's works. Her son, Dr. Robert T. Gunther, curator of the Lewis Evans collection at Oxford, is a well-known zoologist, and the family tradition in this respect is maintained by his son, Mr. E. R. Gunther, one of the naturalists of the *Discovery* investigations, now on board the R.R.S. *William Scoresby* in the Antarctic.

To many generations of the wearers of the scarlet gown, the erect and dignified figure of Prof. M'Intosh must have seemed as much a part of St. Andrews as the United College Tower or the links or the sea. Many who never entered his class-room will have learned of his death with a sense of personal loss. W. T. C.

Mr. T. C. Cantrill.

Mr. Thomas Crosbee Cantrill, who died on April 3 at the age of sixty-three years, was one of the pupils who studied under Prof. Charles Lapworth at Birmingham, where he graduated as B.Sc. At the age of twenty-eight he joined the Geological

Survey of Great Britain, and served continuously on the field staff for thirty-one years, being appointed a district geologist in 1914.

Attracted to geology at an early age, Cantrill investigated the structure of the Forest of Wyre, but after joining the Geological Survey his work was for a considerable time centred in the South Wales Coalfield under the superintendence of Sir Aubrey Strahan. Thereafter he took charge of the West Midlands district, of which Birmingham may be regarded as the centre, but he also edited and prepared for publication several memoirs on the North Wales Coalfield.

The principal contributions made by Cantrill to geological literature will be found in the long series of Geological Survey memoirs to which he was a contributor. Thus, for example, he was one of the authors of nine memoirs on the South Wales Coalfield and of more than a dozen other memoirs on the West Midlands and North Wales. As a coalfield geologist he had not only vast experience but also sound judgment and great diligence. After a breakdown in health in 1921 he resumed his official duties, retiring in 1927, when he took up his residence in his native county of Worcestershire and devoted his leisure to the study of archæology, of which he had always been an enthusiastic student. Several contributions from his pen on these subjects have appeared in the publications of local antiquarian societies.

Cantrill was a field geologist who showed great devotion to his work and exerted much influence on his colleagues by the strength of his character and the unselfish manner in which he gave assistance to all who made demands on him. Though naturally of a somewhat retiring disposition, he made many friends in the districts in which he worked, who were attracted to him by his kindly disposition, his sincerity, and his sympathetic personality.

WE regret to announce the following deaths:

Sir Byrom Bramwell, lately president of the Royal College of Physicians, Edinburgh, and a distinguished neurologist, on April 27, aged eighty-three years.

Prof. Raoul Gautier, honorary professor of astronomy in the University and director of the observatory of Geneva, who was vice-president of the International Association of Geodesy, on April 19, aged seventy-seven years.

Dr. Emil Trinkler, known for his explorations in Afghanistan in 1924 and in the Kuen-lun Mountains, Afghanistan, and Tibet in 1927–28, on April 19, aged thirty-five years.

Dr. A. P. Weiss, professor of psychology at the Ohio State University and associate editor of the *Journal of General Psychology*, on April 3, aged fifty-one years.

News and Views.

FOR many years now, a popular belief has existed that seeds which have been removed from ancient tombs retain their ability to germinate. Wheat grain, the so-called 'mummy wheat', has been a case in point for several decades. This question was brought forward again during the discovery and examination of the tomb of Tutankhamen in 1923, by Mr. Howard Carter and Lord Carnarvon, and has received attention from various quarters since that date. Now another claim has been made by an American farmer, that wheat taken from the tomb of Tutankhamen has been made to grow, and this fact has received much publicity in the press. It is all a question of viability. The viability of a seed depends on several factors, both internal and external. Some seeds will not germinate immediately, and are said to be dormant, such dormancy again being conditioned by after-ripening processes, etc. The result is that seed viability varies considerably within the plant kingdom. For example, the acorn is viable for one season only, whereas charlock will last for twenty or thirty years. Hawthorn, even given germinating conditions, remains dormant for the first season; but immature wheat will germinate, given the necessary conditions, as seen in the case of wheat germinating when still in the ear, during a wet season. On the other hand, mature wheat is viable for some considerable time. Not only that, the grain can withstand extreme conditions to an exceptional degree.

OTHER plants show a similar tendency. The subject was discussed in an article by the late W. Botting Hemsley in NATURE of May 2, 1895, p. 7, exactly thirty-six years ago. He states there that kidney bean seeds, which had remained in the herbarium at Tournefort for a hundred years, germinated; and *Mimosa pudica* will remain viable for sixty years. But the viability of wheat thousands of years old is a different matter. Sir E. A. Wallis Budge states in the *Times* of April 23 that grain from a tomb of date 1200 B.C. was tested for him by the late Sir William Thiselton-Dyer at Kew, and gave negative results. Many others, too, have tried since, with similar results. Yet, such positive results as claimed by some, need explaining. The question is: Were such claimants sure of their wheat? For hundreds of years, the halls of tombs have been used as granaries by the natives. The grain can conceivably be ascribed to that, and therefore possibly be only a few years old. Also, 'mummy wheat' has become so popular that guides have resorted to tricks whereby they dig up 'mummy wheat' (in the presence of the tourist) which the guides themselves had placed there some time before. So far, there has not been one authentic case of 'mummy wheat' being viable, and it is extremely unlikely that there ever will be. A viable seed is still living and therefore respiring, however slowly. Decay is therefore taking place, since there is no anabolism. Such decay varies in rate; but it is not likely that it is so slow as to last over thousands of years.

ON April 23, an Empire trade gathering which emphasised the enormous wealth in precious metals of the British Empire, and especially of Canada, assembled at the Acton Precious Metals Refinery for the opening of extensions. The ceremony was

followed by a luncheon, at which Lord Weir presided, the Government being represented by the Right Hon. J. H. Thomas, and the Dominion of Canada by the Hon. G. H. Ferguson. The extensions have been necessitated by the enormous new supplies of platinum metals recently developed in the Sudbury district of Ontario, as by-products of nickel and copper. These are expected to be produced in the proportions of: platinum and palladium, about 40 per cent each; rhodium, ruthenium, osmium, and iridium, 7 per cent; and gold, 13 per cent. When the Refinery was first opened in 1924, its capacity was 40,000 ounces a year, whereas its extended capacity will be 300,000 ounces. Since the total world consumption is less than 400,000 ounces per annum, the Acton refinery will be able to refine from Empire sources three-quarters of the world's demand.

THERE already exists a wide variety of uses for platinum metals and these will naturally be developed further as the new supplies become available. Platinum itself, found until recently exclusively in sands and gravels and chiefly in the Urals or Colombia, apart from its use in jewellery, is of first importance to the dentist and the surgeon, and is used extensively in laboratories on account of its high melting point and immunity from most chemical reagents. It is also used in the making of permanent photographic prints, in the ceramic industry, in the artificial silk industry for spinnerets, and for many electrical purposes. Agriculture throughout the world depends on platinum, as fine platinum gauze is used in the oxidation of ammonia during the manufacture of synthetic fertilisers. Of the other precious metals, palladium is used for much the same purposes, but it is anticipated that further uses will now be found. One in course of development is the plating of white gold and silver to render these metals non-tarnishable. The palladium-plating of microscopic parts, spectacle frames, and automobile and aerodrome reflectors, to render them non-tarnishable, is rapidly approaching the commercial stage. The other platinum metals are mainly used to alloy with platinum and palladium. Platinum was discovered so far back as 1750, and ruthenium, the last of the group, no more recently than 1845.

AT a meeting of the Section of the History of Medicine of the Royal Society of Medicine, under the presidency of Sir Humphry Rolleston, on April 15, his brother, Dr. J. D. Rolleston, an ex-president of the section, read a paper entitled "Jean Baptiste Bouillaud (1796–1881): a Pioneer in Cardiology and Neurology". Bouillaud's treatise on diseases of the heart, of which the first edition was published in 1835 and the second in 1841, formed an important landmark in the history of cardiology, his two chief French predecessors in this field being Senac, the contemporary of Voltaire, and Corvisart, the medical attendant of Napoleon. The contributions of Bouillaud to cardiology were summed up under the following six headings: (1) the first description of the endocardium and endocarditis; (2) his 'law of coincidence', in accordance with which affection of the heart is the rule in acute rheumatism; (3) his elaborate studies of the normal heart, whereby he created a new department of topographical anatomy; (4) the importance which he attached to auscultation of the heart in contrast with Laennec, who under-estimated its value in cardiac as distinct from pulmonary diseases; (5) his description of new physical signs in cardiac disease, and (6) his detailed account of congenital heart disease.

THE pioneer work of Bouillaud in neurology consisted in his identifying the anterior lobes of the brain as the seat of speech thirty-six years before Broca, who, though he localised it more precisely in the third left frontal convolution, acknowledged his indebtedness to Bouillaud, and in showing that the cerebellum was concerned with movements of co-ordination, in opposition to Gall, who regarded it as the organ of the instinct of propagation. In addition to his contributions to cardiology and neurology, he made an important advance in the study of acute rheumatism, which is still known in France as Bouillaud's disease. Although a stalwart vitalist, he was one of the first to recognise the importance of chemistry and physics in medicine, in contrast with his contemporary the great clinician Trousseau, who was inclined to depreciate the value of these studies. In conclusion, Dr. Rolleston showed by quotations from contemporary literature that Bouillaud never received much appreciation during his lifetime in Great Britain, and suggested that the chief cause of the oblivion into which he had fallen was his practice of repeated and free venesections, with which he persisted long after it had been generally abandoned elsewhere.

THE April issue of the *Hibbert Journal* contains an interesting article by Sir Oliver Lodge on "The Interaction of Life and Matter". He attempts to interpret the behaviour of animated bodies in terms of a "biological field", just as the behaviour of inanimate particles is interpreted in terms of an electric or magnetic field. He admits that the parallel is not complete. "In a gravitational or an elastic or any other field, energy is stored and expended: those fields belong to the physical universe, and their energy has to be taken into account. In life apparently there is no specific energy. Life is not energy, it merely directs the energy which it finds available." The element which life adds is not energy but guidance; it directs energy into channels which otherwise might have been unoccupied. Yet how life can direct energy without expending energy itself has always been an insoluble problem.

SIR OLIVER LODGE here suggests that the possibility of a directive yet non-energetic agency is not excluded by the present state of physical knowledge. "Modern physics has shown that every particle has associated with it something periodic. The electron does not now appeal to us as a minute spherical charge and nothing else; it has been found to have something associated with it, a series of waves. In fact, it is found that many of the properties of a particle of

matter can be possessed by what is known as a 'group wave'; in other words, that the energy of a particle can be expressed as the energy of a set of group waves, and that these, strangely enough, obey the laws of dynamics. Consequently it is realised that the particle and the wave are much more united than ever they have been before. A wave may exist without a particle. A particle can hardly exist without a wave. The waves seem the most fundamental things." Of these waves, Sir Oliver says that they are "mere forms that convey or transmit no energy", they are in fact "not effectively energetic"; "their progress is not like that of a material entity, and yet they are supposed to guide the particle to its destination". In other words, they "exercise a controlling and directing influence without imparting any energy". They may be said to act like the rails which guide a train. The hypothesis suggested is that "these form waves constitute the physical mechanism whereby life and mind operate on and direct material particles". The suggestion is an interesting one, and we shall wait to see how far this application of recent physical theory will commend itself to physicists on one hand and to physiologists on the other.

THE Friday evening discourse on April 24 at the Royal Institution was given by Sir Philip Hartog, on Joseph Priestley. Sir Philip pointed out that Priestley was one of the most conspicuous figures in the eighteenth century, and has always seemed puzzling to his scientific biographers. Some of Priestley's best work is contained in his "History of Electricity" and his electrical papers, which have been very largely overlooked. He discovered that charcoal, blacklead, and red-hot glass are conductors, suggested that there was a gradation of substances from the most perfect conductors to the most perfect non-conductors, and tried to measure conductivity. He anticipated Cavendish and Coulomb, by showing from an experiment of Franklin, elaborated by himself, that the attraction between quantities of electricity varies inversely as the square of the distance. Priestley initiated a new era in chemistry by increasing the number of known species of gas from three to twelve, and paved the way for the revolution effected by Lavoisier. His discoveries of the action of living animals on air, of oxygen on blood, and of the green matter of plants on air under the influence of light, have been of the greatest importance in animal and plant physiology. Finally, it appears from notes for a lecture in the Royal Institution in 1810 that it was a theorem of Newton's and certain observations of Priestley on the diffusion of gases that led Dalton to his atomic theory. Priestley's place in the history of science has been under-estimated. There have been greater men of science than Priestley, but few whose discoveries have produced so rich a harvest.

DR. J. F. TOCHER, Croll lecturer in statistical methods in the University of Aberdeen, gave an address on April 24, at the Institute of Chemistry, on probable error in scientific investigations, especially those relating to physics and chemistry. In reviewing the methods of testing the accuracy of results, he demonstrated the fact that it is unsafe to rely on an average alone as representing the real value, even if a large number of observations have been carefully conducted to obtain it. It is necessary to make certain that all systematic errors due to the apparatus, the method, and the observer have been avoided. When these have been eliminated, the individual results follow the law of error and contain only the unavoidable experimental errors, similar to those in making an attempt to measure a yard correctly. The measure of these unavoidable errors is known as the probable error, a single figure which gives a shorthand description of the extent of the variation in individual measurements. Dr. Tocher gave examples, among others, of determinations of the atomic weight of hydrogen by Rayleigh, Morley, and others, and showed that, despite the extremely sensitive nature of the apparatus and care taken to secure accuracy, the results show a rhythmical variation. They swing from side to side round a specific value. Sometimes, however, the individual results rise beyond the limit of unavoidable or random variations and betray an increase or a decrease which is systematic and avoidable. All that those engaged in research can do is to repeat their experiments until they acquire confidence in their accuracy and are able to formulate a reliable result. The calculus of probabilities has an important place in science; Clerk Maxwell described it as the true logic for this world and the only mathematics for practical men.

THE rapidly growing steel constructional work of the great electric power station at Battersea can now be seen from the Embankment. On St. George's Day, April 23, a remembrance-stone, built into the station, was unveiled by Mr. W. F. Fladgate in honour of Michael Faraday, and a speech by Lord Bessborough, Governor-General of Canada, who is a former director of the London Power Co., was telephoned by radio and broadcast at the ceremony. Lord Bessborough paid a glowing tribute to Faraday, who is recognised as the founder of the electric industry as we know it to-day. A hundred years ago, after much patient research guided by marvellous foresight, he discovered the phenomenon of the induction of electric currents and tabulated the laws governing it. Lord Bessborough said that science has no frontiers; the whole world is its parish. He pointed out that to Canada the 'white coal' of electrical energy means perhaps more than can be measured in the development of the Dominion. In the great metropolis of the Empire, this potent force is working for the betterment of the people in many ways. Faraday's discovery has been a boon to the world, and the Canadians participating on the other side of the Atlantic remember with gratitude the beneficent debt they owe to Faraday. After the remembrance-stone was unveiled at the request of Lord Bessborough, Mr. Fladgate used a telephone near the tablet to convey the thanks of the assembled company to the Governor-General.

THE Moorside Edge station of the British Broadcasting Corporation has now been completed. It is

the northern counterpart of the Brookman's Park station. It is situated 1100 feet above sea-level, about five miles from Huddersfield. The three 500-feet masts can be seen from the L.M.S. Railway which connects Manchester with Leeds. Work has been begun on the third regional transmitter, near Falkirk, in Scotland. The fourth is to be located in Somerset, but the site has not yet been chosen. As each of the regional stations will radiate on two wave-lengths, transmitting alternative programmes, and as Daventry (5XX) and Belfast each radiate on one wave-length, the whole of the ten wave-lengths available will therefore be used. The general equipment and layout of the Moorside Edge station practically duplicates that of Brookman's Park. Great precautions have been taken to avoid interruptions to the programmes. In each circuit, spare valves are provided which can be put in circuit at once by merely operating a switch. The condensers and inductances are not bolted down, so they can if necessary be disconnected and removed at once. The aerial masts, which form a right-angled triangle, are of lattice steel construction and each weighs 40 tons. To avoid any unsymmetrical radiation from the aerials by 'mast shadow effect', each mast is insulated from the earth by porcelain insulators. The formation of ice on the aerials, which might overload them mechanically is guarded against by passing large currents from the generators through suitable conductors on the masts, the required heat being given in about half an hour. For its regional transmission, the Moorside Edge station will use a wave-length of 479 metres, and for broadcasting the national programme it will use a wave-length of 301·5 metres.

Two valuable papers on standardisation have recently been read. The first of these was read to the Royal Society of Arts on Feb. 4, by Mr. C. le Maistre, director of the British Engineering Standards Association, and was entitled "The Effect of Standardisation on Engineering Progress". Referring to the present widespread dislocation of industry, which requires to be made the subject of scientific and systematic investigation rather than of party politics, he said the purpose of his paper was to show, in some small measure, the contribution which standardisation can make towards the solution of the problem by the introduction of greater economy in manufacture and distribution. No one imagines there is any single remedy for trade depression, but it is an undoubted fact that standardisation, properly organised, is a most important factor in diminishing the excessive ups and downs from which industry suffers. The second paper on the subject was read to the Institution of Automobile Engineers on Mar. 3, by Mr. L. A. Legros. Commencing with a sketch of the history of standardisation, Mr. Legros referred to the formation, in January 1901, of the Engineering Standards Committee, from which the British Engineering Standards Association sprang, to the work of standardisation done in connexion with the motor industry, to the progress of provisional standardisation, and to many practical aspects of the subject. Quoting from an article by Mr. B. D. Porritt, he said: "Standards should result in something more than the stabilisation of quality and testing; it should be a fruitful field for improvement on both sides. If the time had come to visualise a national standardisation authority, such a body should treat standardisation as a means to the enhancement of the reputation of British goods."

THE syllabus for the present term of broadcast talks to schools on rural science has recently been published by the Central Council of School Broadcasting. There are two series of talks. Mr. C. E. Hudson is giving four talks on "The School Garden", on May 1 and 15 and June 5 and 19. Types of useful flowers for the school garden will be considered, and also methods of propagation by seeds and vegetatively and artificially (grafting and budding). The treatment of fruit trees, with special reference to pruning and fruit thinning, and the effect of such treatment will conclude the actual scientific considerations. This will be followed by the last talk, which is on the vocational possibilities of horticulture. This should prove of exceptional interest, especially to children of rural schools in the vicinity of an agricultural or horticultural college. "The Plant and the Soil" will form the subject matter of the other series of talks, to be given by Mr. Ward Cutler. This series will be composed of four talks, on May 8 and 22 and June 12 and 26. The series will begin by considering soil formation, and then various types, especially clay and chalk, with their typical flora, will be described. Some very useful experiments are to be described, experiments which may easily be set up without the necessity for any elaborate apparatus. The programme contains several good photographs and diagrams. Judging from this pamphlet, the rural schools should look forward to two interesting and useful series of talks.

THE *Bodleian Quarterly Record*, vol. 6, No. 68, recently issued, contains a reprint of some exchequer accounts of the reign of Henry VI. which give a description of a hitherto unrecorded visit of the King to Oxford in February 1439, the object of the visit being to witness a demonstration by a body of German master-gunners and their company of their methods of projecting 'wild-fire', an incendiary composition better known as Greek fire. In an introductory note to the documents, Mr. E. W. Hulme says that the German artificers were brought to England by John Solers and that they stayed in Oxford nine days. The employment of German artillerists in England was customary at this period. On Nov. 3, from Henry VI. is recorded the payment of £40 "To Gokyn Gunner, Walter Lokyer, Walter Hermanson, and Gerard van Ewe, Gunnemeysters" from Germany, who for a long time remained in the King's service. The name of John Solers occurs fairly frequently in the national records. In 1438 he was appointed sergeant of the King's tents and pavilions, and in 1439 he obtained a twenty years' lease of all mines in Devon and Cornwall producing gold or silver, at a rent of one-fifteenth of the precious metals. The place of the German experiments in the history of the use of incendiary compositions in war can be found

by a study of Col. Hime's "Origin of Artillery" and von Romocki's "Geschichte der Explosivstoffe".

THE Council of the National Institute of Industrial Psychology has recently issued its tenth annual Report (for the year ending Dec. 31, 1930). In spite of the trade depression, the various activities of the Institute have increased in number and scope, and it is noteworthy that the importance of the human factor in industry is becoming recognised more and more. Membership of the Institute has increased from 1430 to 1600, more requests are made for vocational guidance, and investigations have taken place in such varied industries as railways, meat paste, stores, and chocolate. An important development is that firms are beginning to send their applicants for posts to be advised by the Institute as to the branch of the work for which the candidates are most fitted. Apart from investigations, the Institute is doing research work into the nature and measurement of the mental abilities involved in factory assembly, colour discrimination, tests for perseveration, occupational prospects for boys, tests for motor drivers, etc. Lectures and demonstrations have been in increasing demand. A special appeal is being made for funds to continue the work, as research work cannot in the nature of the case be self-supporting, and in memory of the Institute's first president it is proposed to call it the Balfour Memorial Fund.

THE first number (vol. 1, No. 1, pp. 1–96) of the new publication, the *Veterinary Bulletin*, has recently been published; as announced in NATURE of April 25, it is to take the place of the *Tropical Veterinary Bulletin*, which ceased publication with the December number, with the addition of matter relating to animal diseases of temperate climates. The *Veterinary Bulletin* will deal with all aspects of animal health in so far as they relate to original research and administrative control, but it will not deal with clinical material from the point of view of the practitioner; book reviews will be included. The *Bulletin* will be of crown quarto size, 9¾ in. by 7¼ in., and vol. 1 of this year will be issued quarterly and will run to about 384 pages. From Jan 1, 1932, the journal will be published monthly and the volume will run to about six hundred pages. The journal is published by the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, England, and the subscription price for the volume is £1, post free, payable in advance to that address (single copies will be 7*s*. 6*d*.). The subjects dealt with are classified under fourteen headings, most of which are represented in the abstracts in this first number. Among the contents we notice that several pages are devoted to the *BCG* (Bacillus Calmette-Guerin) vaccine for tuberculosis, a subject which is attracting much attention at the present time, and nearly seven pages to *Bacillus abortus* infections and abortus and undulant fevers in man, another subject of much importance.

THE Zoological Department of the British Museum (Natural History) has acquired, by purchase, a mounted specimen of a gerenuk, or Waller's gazelle (*Lithocranius walleri*). The animal has been mounted standing on its hind legs in the browsing attitude adopted by this species. Although this antelope has been known to science only during the last fifty-three years, excellent figures of it are found in Egyptian rock-carvings believed to date from about 5600 B.C. Its distributional range includes a very large part of the desert country of East Africa. The Museum has also purchased the skin and skull of a pigmy hippopotamus (*Choeropsis liberiensis*). This species is found in Liberia and Sierra Leone. The animal is not gregarious, spends most of its time on land, and is strictly nocturnal in its habits. The zoological and entomological collections have been enriched by a large amount of material obtained by Capt. A. K. Totton whilst a guest of the Atlantic Fleet during its recent visit to the West Indies. The Department of Geology of the Museum has acquired some Jurassic insects from Bavaria, and a unique collection of Australian Triassic fishes. The former are preserved in the famed lithographic stone of Solenhofen, and comprise some exquisite dragon-flies. The latter were gathered from a quarry, now closed, near Sydney. This fish-fauna is the only one known from the Middle Trias of Australia. H.M. the King has sent 673 specimens of dried plants from Nepal on loan to the Department of Botany. The flora of Nepal is very little known, for only a small area has been explored botanically. The Friends of the National Libraries, with the co-operation of one of their members, Mr. Basil H. Soulsby, have presented to the Library a copy of Robert John Thornton's rare work "Botanical Extracts, or the Philosophy of Botany", in four volumes (London, 1798–1810). Dr. Thornton (1768–1837), a distinguished member of Guy's Hospital, spent many thousand of pounds on producing botanical works, and in 1811 Parliament sanctioned the Royal Botanical Lottery, to which the Prince Regent gave his patronage.

THE general subject of the International Industrial Relations Congress to be held at Amsterdam on Aug. 23-29, is announced as "Social Economic Planning—The Necessity for a Planned Adjustment of Productive Capacity and Standards of Living". The main object of the conference is the integration of the economic and political factors responsible for the maladjustment which causes so much unemployment in the midst of economic progress. Such resolution of the disturbing factors is essential to political and economic co-operation in the planning and adoption of development policies in production and standards of living if policies are to be based on economic facts. The programme includes addresses on the "Significance of World-wide Unemployment", by Dr. Max Lazard, Paris; "Recent Growth in the World's Productive Capacity", by Dr. Otto Newath, Vienna; "The Problem of Planned Economy", by Dr. L. Lorwin, Washington; "Principles and Practice of Scientific Management", by Dr. H. S. Person, New York, and H. von Haan, Geneva; "Experience and Potentialities in International Economic Treaties", by Prof. J. P. Chamberlain, New York; "International Planning by Industries", by

Prof. M. J. Bonn, Berlin; "Mass Distribution and Standards of Living", by E. A. Filene, Boston, U.S.A., and "International Agreement on Labour Standards", by M. Albert Thomas. These addresses will be followed by discussions, and other discussions are announced on "Potentialities in National Economic Planning", "The Co-operative Movement", "The International Bank: Its Potential Relation to Planned Production", and "The Economic Basis of Regional Agreements".

THE Advisory Committee on the Welfare of the Blind has issued its ninth *Report*, 1930, to the Minister of Health (H.M. Stationery Office, 1931. 6*d*. net). It is estimated that the blind population of England and Wales on Mar. 31, 1930, numbered 56,853. Attention is directed to an experiment in sub-contracting for the manufacture of 'forms' for telephone bell sets by blind persons. There were no complaints as to the quality of the work, and the output was satisfactory, averaging two-thirds that of sighted workers. The experiment confirms conclusions already reached by psychological analysis, namely, that skill in executing a movement depends both upon a muscular control which is independent of vision and a visual control, and totally blind persons must always suffer a handicap in this respect.

AT the end of last year, Prof. A. A. Ivanoff retired from the position of Director of the Observatory in Pulkovo and took over the office of the President-Adjoint of the Central Chamber of Weights and Measures (Leningrad, Mezhdunarodny Prosp., 19).

THE following have been proposed for election as honorary members of the German Chemical Society: A. Angeli (Florence), E. J. Cohen (Utrecht), W. Ipatiew (Leningrad), I. Langmuir (Schenectady), H. Le Chatelier (Paris), Sir William Pope (Cambridge), The Svedberg (Upsala), E. Warburg (Berlin).

THE following have been elected as officers of the Physical Society of London, for 1931–32: *President*: Sir Arthur Eddington; *Secretaries*: Dr. Ezer Griffiths and Dr. Allan Ferguson; *Foreign Secretary*: Prof. O. W. Richardson; *Treasurer*: Mr. R. S. Whipple; *Librarian*: Mr. J. H. Brinkworth; *Assistant Secretary*: Dr. J. J. Hedges; *Editor*: Capt. C. W. Hume.

THE council of the Royal Geographical Society has made the following awards for 1931: The Murchison Grant to Mr. L. M. Nesbitt, for his difficult journey through the Danakil country of Abyssinia; The Back Grant to Col. R. H. Rowe, for his surveys in Nigeria and on the Gold Coast; The Cuthbert Peek Grant to Mr. H. J. L. Beadnell, for his explorations in the Libyan Desert; The Gill Memorial to Mr. Michael Spender, for his studies of the Great Barrier Reef.

A SERIES of lectures, the first under the terms of the Heath Clark bequest to the University of London, will be given on May 4, 5, 6, 7, and 8, in the London School of Hygiene and Tropical Medicine, Gower Street, by Sir George Newman, the Chief Medical Officer of the Ministry of Health and the Board of Education, who has taken as his subject "The Rise of Preventive Medicine". All the lectures commence at five o'clock and are open to the public without ticket.

A COURSE of advanced lectures in sociology will be given by Prof. E. Westermarck at the London School of Economics on May 6, 7, and 8, the subject of the lectures being "Pagan Survivals in Mahommedan Civilisation". The first lecture will cover the beliefs in the jinn, the evil eye, and the curse. In the second, Prof. Westermarck will deal with the conception of holiness and the closely related beliefs connected with saintly persons, places, and objects. In the third lecture he will cover Roman and pagan survivals in Mohammedan ritual. Prof. C. G. Seligman will take the chair at the first lecture. The lectures will begin at 5 P.M., and admission will be free to students and others interested.

THE thirty-sixth general meeting of the Deutsche Bunsen-Gesellschaft will be held at Vienna on May 25–28 next. The programme includes a list of thirty papers on various branches of pure and applied physical chemistry and a number of excursions and visits to places of interest. The titles of the separate lectures show that a wide field of interest both in pure and applied science is to be offered at the meeting. The subjects to be discussed include metallography, crystal structure, thermodynamics, spectroscopy, adsorption, and free radicals, and many well-known authorities will take part in the programme. The arrangements made for the accommodation of visitors from overseas and for excursions are complete, and the meeting promises to be one of great interest.

AN invitation is again extended to farmers' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies, and other bodies interested in agriculture or market gardening to inspect the Rothamsted and Woburn Experimental Plots during the coming summer. Mr. H. V. Garner and Capt. E. H. Gregory will be available to demonstrate the plots. At Rothamsted the soil is heavy and the experiments deal with the manuring of arable crops and rotation experiments. At Woburn the soil is light and the experiments are concerned more particularly with the manuring of potatoes, sugar beet, malting barley, wheat, and the use of green manures. All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mechanical engineering at the Handsworth Technical College—The Principal, Handsworth Technical College, Handsworth, Birmingham (May 11). A half-time lecturer in social economics and tutor in academic work in the Department of Social Study of the University of Birmingham—The Secretary, The University, Birmingham (May 13). A Bayliss-Starling scholar at University College, London—The Secretary, University College, Gower Street, W.C.1

(May 15). A research student in experimental physics in the Henry Herbert Wills Physics Laboratory of the University of Bristol—Prof. A. M. Tyndall, The University, Bristol (May 18). Lecturers on, respectively, economics and industrial organisation at the School of Economics and Commerce, Dundee—The Principal, School of Economics and Commerce, Dundee (May 23). Two senior and four junior research scholars at the School of Economics and Commerce, Dundee—The Principal, School of Economics and Commerce, Dundee (May 23). An assistant lecturer in mathematics in the University College of Hull—The Registrar, University College, Hull (May 29). Two tutors for extra-mural education in rural areas, under the Joint Committee of the University of Birmingham and the Workers' Educational Association—The Director of Extra-Mural Studies, The University, Birmingham (May 30). A Sir Clement Royds memorial scholar in chemistry in the University of Manchester—The Registrar, The University, Manchester (June 1). Instructor lieutenants in the Royal Navy, with university training and an honours degree in mathematics, science, or engineering—The Adviser on Education, Admiralty, S.W.1.

Our Astronomical Column.

The Expansion of the Universe.—Sir Arthur Eddington contributes a letter to the April number of the *Observatory*, in which he answers some questions submitted by Mr. B. M. Peek. The expansion is relative to our ordinary standards of length; for example, the wave-length of the red cadmium line may be taken as our standard. Secondly, the expansion is modified by gravitational action. Where there is periodic motion, as in the planetary system, the only effect of the expanding tendency is to lengthen the period corresponding to a given distance from the centre. This would be the case also in the rotation of the galaxy. He differs from Prof. de Sitter, who thinks that the expansion would be effective even in these cases. It is only when we come to the large scale of intergalactic distances that the expansive tendency prevails over the attractions of the galaxies on each other and periodic motion is no longer possible. He says that the problem may also be treated on the basis of taking the radius of space as constant, and our standards of length and time as shrinking. This assumption leads to the anomaly that an infinite number of terrestrial years would have a finite sum, and all matter would disappear in a finite time. Thus he prefers the "expansion of the universe" to the "contraction of the atom".

Collision Theory of Novæ.—The March number of *Scientia* contains an article on novæ by A. C. Gifford, of the Dominion Observatory, Wellington, New Zealand. He examines the various theories current on the subject, such as collision of star with nebula or with a body of planetary size, but expresses his strong preference for the theory of collision of star with star, advocated so persistently by the late Prof. Bickerton. The main difficulty of this theory is that, on the average, novæ appear more often than once a year (including telescopic ones), and that examination of the density of star distribution indicates that collisions between them would be extremely rare. Also, one might expect to see the stars separately, some years after the outburst, but this has not been reported; the appearance in Nova Pictoris after the outburst did not suggest two stars. The theory that the outburst may result from some instability in the star's interior is now gaining favour, but is not noticed by Mr. Gifford; nor does he notice the modification of the theory of collision with nebulæ, namely, that this might produce a blanketing effect, causing the star's heat to be bottled up, ultimately leading to an explosion.

Comets.—Publication No. 74 of Copenhagen Observatory gives the following definitive orbit of the periodic comet 1927 III = 1926 *f* (Comas Sola) by Miss J. M. Vinter Hansen. 199 observations are used, extending from Nov. 4, 1926, to May 31, 1927. Perturbations by Jupiter and Saturn are applied. The question of possible identity with Spitaler's comet (1890 VII) is not dealt with; this depends so much on the exact circumstances of the approach to Jupiter in 1912 that it is better to wait until the next return of the comet in 1935, when the period will be known with exactness. The date of osculation is 1926 Nov. 30·0.

The orbit of comet 1930 *d* (Schwassmann-Wachmann) is by Jorge Bobone of Cordoba, using observations from May 2 to July 8 (*Astr. Jour.*). The elements of comet Pons-Winnecke for the 1927 apparition (by B. Strömgren) are given for comparison. It appears likely that the two comets had a common origin.

Comet.	1927 III.	1927 VII (Pons-Win.).	1930 *d*.
T	1927 Mar. 22·1929	1927 Jun. 21·064	1930 Jun. 14·1756
ω	38° 27′ 50·8″	170° 22′ 35″	192° 18′ 39·0″
Ω	65 35 41·0	98 8 34	76 48 31·9
i	13 45 43·3	18 56 26	17 29 30·0
ϕ	35 6 26·4	43 17 0	42 46 16·5
log q	0·0452093	0·016698	0·004935
Period	8·52094	6·00953	5·5954
Equinox	1925·0	1927·0	1930·0

T is given in U.T. The period of 1927 III is in Julian years. It will be seen that the longitudes of perihelion of the last two comets (that is $\omega+\Omega$) are nearly identical.

Ancient Egyptian Astronomy.—Mmé. Flammarion, who has been travelling in Egypt, contributes an illustrated article to the February number of *L'Astronomie*. She notes that the crescent is often associated with the goddess Hathor, corresponding to Venus, and conjectures that Venus may have been seen as a crescent in Egypt. The same conclusion has been drawn from the name Ashteroth Qarnayim (Astarte of the two horns), which also corresponded to Venus. She reproduces a photograph of the well of Eratosthenes at Assuan and describes the determination of the circumference of the earth which he made with its aid. It is pointed out that in the time of Eratosthenes the well was 21′ north of the tropic of Cancer; but it may have been made many centuries earlier, when the obliquity of the ecliptic was greater. The article states that, according to an ancient tradition, the sun completely lit up the well of Syene at the solstice. This would have been the case about 3000 B.C., the date usually assigned to the pyramids. A picture of the temple of Denderah shows the winged solar disc, which has been plausibly conjectured to have been suggested by the aspect of the corona, especially at sunspot minimum. The article combines ancient with modern by giving a picture of Helwan Observatory, and another of a battery of telescopes set up by astronomical tourists on the terrace of the Winter Palace at Luxor.

Research Items.

Excavations in British Honduras, 1930. — The season's work of the British Museum Expedition to excavate Maya ruins in British Honduras in 1930 was planned to cover (1) excavation on the masonry and terrace complex at Pusilhá ; (2) a survey of the new site and the remains of the prehistoric bridge on the other side of the river ; and (3) to bring back the two monolithic stelæ which it had been impossible to remove in the previous season. Capt. E. L. Gruning's report on the season's work is published in the *Journal* of the Royal Anthropological Institute, vol. 60, pt. 2. Owing to exceptional rains, the work of excavation and transport was much hindered, and it was possible to bring back to England only one of the stelæ. The terrace site was generally explored. Owing to lack of time, it was not possible to explore an interesting structure resembling two-thirds of a pyramid which was discovered, but a substructure on terrace 3 was excavated and produced some remarkable finely flaked flints, some of which are in the form of snakes and scorpions, and a number of jadeite beads. A carved plaque, or pendant, of jadeite from an excavation south of the river, was engraved with a design which the author calls the " begging jaguar with a glyph head ". This, it is believed, is unique. One of the jadeite beads has ' turk's head ' engraving and recessed cavities for inlay. Remarkable also are certain double shells (of the *Spondylus* genus) which had evidently been imported from the coast and had been buried with the owner. They contained small personal ornaments and had evidently been used as jewel boxes. Among the contents of one was a semi-circular pendant of jadeite and blister pearls pierced for suspension.

The Mesolithic Human Remains from Mugem.—In *L'Anthropologie*, vol. 40, No. 4, Dr. Henri. V. Vallois reports on an examination of the skeletal remains from the kitchen-middens at Mugem, Portugal. Previous accounts of this material have been confined to the remains of a few individuals. These have been re-examined, and all other specimens available have also been measured. All the skeletons here considered come from two middens only, those from the third evidently being of more recent date. The conclusions drawn require certain modifications in the views put forward by previous writers. Although female skulls are certainly more numerous, they are not double the number of the males as stated by Paula ; nor do they show the number of aged individuals claimed, although a considerable number had attained years of maturity, say from thirty to fifty years of age. It has generally been agreed that the skulls include both dolichocephals and brachycephals; but this also requires qualification. The mean cephalic index of the dolichocephals is 70·9. Though high, the skulls do not show the tendency to hypsistenocephaly claimed by Mendes-Correa. The face is mesoprosopic, mesorhine, and mesognathous. Dental caries is present. Of the brachycephals, which are much less numerous than the dolichocephals, it may be said that their condition does not allow any certain conclusion ; they are much deformed, and in such a way as to increase the transverse diameter. Of seven skulls, four without question are mesocephalic ; and question arises whether the brachycephalic race of Mugem, of which much has been written, is really brachycephalic. The question must be regarded as open, pending further discoveries, and in future we should speak of the mesocephalic rather than the brachycephalic type of Mugem. The various theories put forward as to the affinities of the dolichocephalic type are unsound. It is probably nearest to Cro-Magnon.

Pictures of Some Abyssinian Birds and Mammals. —Artistic pictures of birds, at the same time accurate enough to satisfy the ornithologist, are rare ; and therefore the album of coloured reproductions of thirty-two paintings, a *Special Publication* of the Field Museum of Natural History, Chicago, is an unusual treat. It contains twenty-eight pictures of Abyssinian birds and four of mammals, from paintings by the late Louis Agassiz Fuertes. The writer watched with interest the rapid progress of Fuertes' work, from his first rather crude pictures of American birds to the fine finish which he attained, and these Abyssinian pictures mark the summit, as they unfortunately mark the close, of his artistic work. No expense has been spared in creating exact reproductions, and eight and sometimes nine colours have been used in the ' offset ' lithographic process. The brightness of the colours and the interest of the forms seized upon by the artist give real charm to the collection, which is published through the generosity of Mr. C. Suydam Cutting.

Growth in the Hermit-Crab.—The hermit-crab provides opportunities for the study of growth-potentials associated with asymmetry, here seen in the larger size of the right thoracic limbs, the right-handed twist of the abdomen, and the strong heterogonic growth of the male right chela. The results of measurements on 56 male and 64 female *Eupagurus prideauxi* are given by S. F. Bush (*W. Roux Archiv. f. Entwicklungsmechanik*, 123-1, pp. 39-79). In the absolute size of the limbs, predominance of the right side is greatest in the chela. Posteriorly it grades over into left predominance, starting at the fifth pereiopod in the male, and the fourth in the female. The females throughout show less right predominance. The limbs do not all grow at the same rate: there is a definite gradient, which, the right chela ignored, is identical on both sides of head and first seven thoracic segments. There is a maximum at the 3rd pereiopod, from which point, both anteriorly and posteriorly, the growth rate diminishes in a graded series. In the male the gradient is most marked. Here the chela and following two pereiopods are positively heterogonic, the right chela to an exceptional extent. The latter, though breaking the regular gradient on the right side, does not influence the growth rates of the limbs on either side of it. If the chela exerts any influence on neighbouring limbs, it is in the matter of absolute size, and it is noteworthy that right-predominance is greater in the limbs immediately posterior to it than in those anterior. Comparison of males and females shows male-predominance, which is greater on the right side and increases during growth, from the 1st antenna to the 4th pereiopod, grading into female-predominance anteriorly (eye-stalks) and posteriorly. This gradient also has its summit at pereiopod 3, and is broken on the right side by the great predominance of the chela. The growth gradient within the chela is the same as that within the other pereiopods at first, but the centre shifts with increased growth.

On Unsegmented Ova of Echidna.—T. Thomson Flynn (*Quart. Jour. Micr. Sci.*, vol. 74, part 1; 1930) describes two unsegmented intra-uterine ova of *Echidna*. The egg is about 4 mm. in diameter and has a delicate transparent shell, a thin layer of albumen, and then the white yolk mass (with the germinal disc on one side) enclosed in the very thin zona. In each egg, the two polar bodies had been formed. They are smaller than those described for *Ornithorhynchus*, and the first polar body is much larger than the second and, contrary to what has been reported for *Ornithorhynchus*, remains undivided. In

the second egg the two germ nuclei—one slightly larger than the other—were closely apposed preparatory to the formation of the first cleavage spindle.

Inheritance of Mutual Aversion in an Ascomycete.—A further study of the mutual aversion which occurs between the mycelia derived from different spores of the Ascomycete *Diaporthe perniciosa* has been made by Miss D. M. Cayley (*Jour. Genet.*, vol. 24, No. 1), who also reviews the occurrence of this phenomenon in other fungi and its relation to the various forms of heterothallism. She adopts the nomenclature of Correns, in which the simple form of heterothallic condition due to + and − strains is called haplo-heterœcious, and classifies five different types of heterothallism in the fungi. From extensive single spore cultures of *Diaporthe* and testing the reactions of the resulting mycelia, she finds that this fungus shows, in addition to the ordinary sex heterothallism, a physiological heterothallism based on inter-racial and self-sterility factors which influence the sexual affinity of the haplonts but segregate in ascospore formation independently of sex. The capacity for mutual aversion is thus inherited and occurs in two forms, (1) inter-racial, (2) intra-perithecial as shown by the haplo-heterœcious form only. The former is a kind of sterility between biological races, the latter a form of physiological self-sterility independent of sex. Aversion is marked by a line where two mycelia meet and refuse to intermingle, and the two types of aversion are not visibly distinguishable. Four ascospore generations were grown from a particular pycnospore culture, the results being stated in a factorial scheme. It is found that different asci in the same perithecium can give different types of segregation of the self-sterility factors, and that the progeny of a single perithecium may or may not show aversion, dependent upon the type of segregation which has occurred in the formation of the ascospores. Mono-ascospore cultures will not form perithecia and some mycelia can throw mycelia of the opposite (aversive) group. Incidentally, the use of the term archegonium for the female sex organ of a thallophyte is to be deprecated.

Nucleoli of Rice Varieties.—A cytological study of five varieties of rice from Japan, India, Java, and Egypt has been made by A. G. Selim (*Cytologia*, vol. 2, No. 1), who finds interesting differences in the nucleoli of various forms. All the varieties have the same number of chromosomes ($n = 12$) and the same size of nuclei, but the nucleoli in the resting stage of the pollen mother cells show constant differences in average size. In the variety having the largest nucleolus, it regularly divides before synizesis into two of equal size. In the next variety, a smaller nucleolus is budded off from the primary one; in the third variety this division takes place later (after synizesis); while in two other varieties having the smallest nucleoli, they usually remain undivided. The nucleolus which is budded off from the primary one remains attached to it, but disappears earlier in the prophase than the other, and is believed to contain chromatin which is contributed to the chromosomes. It is suggested that this secondary nucleolus corresponds with the nucleolar body found in *Lathyrus* and other forms. Similar observations are included on meiosis in the megaspore mother cells. This is the first case in which varieties having the same chromosome content are found to be differentiated by the character of their nucleoli. These differences are correlated with the relative and absolute size of the single nucleolus present before meiosis begins. The work also confirms other evidence that the nucleolus of plant cells contains two different substances.

Fossil Reptilian Egg from Yorkshire.—The *Annual Report* of the Yorkshire Philosophical Society, for 1930, issued Mar. 31, contains a description by Sidney Melmore of an object in the Edward Wood collection, now in the Yorkshire Museum, from the Lias of Whitby. This, from its general shape and mode of preservation, Mr. Melmore regards as probably a reptilian egg, possibly of a crocodilian. He deduces the size as 8·5 cm. by 6·0 cm. The outer layers, unfortunately, are pyritised and show no structure.

An Extinct Tasmanian Marsupial.—Prof. Wood Jones has re-examined the well-known extinct marsupial from Tasmania, *Wynyardia bassiana*. Hitherto this form has been considered as an Eocene form and as differing in many respects from any living marsupial. Wood Jones, in the *Proceedings* of the Royal Society of Tasmania, 1930, after a careful reinvestigation of the original specimen, has come to a conclusion which is in direct opposition to that which has hitherto been generally accepted. More recent research has shown that the beds from which the fossil came are much later than the Eocene and are probably late Miocene or even Pliocene. The animal itself has no character that distinguishes it from modern marsupials and many that ally it to the living genus *Trichosurus*.

Comparative Study of Soil-Profiles.—Under this title a note on an important investigation of soil-profiles in Holland and Java (*Mitt. Geol. Inst. Landbouwhoogeschool in Wageningen, Holland*, No. 16, 1930) was published in these columns on Feb. 7, p. 214. Unfortunately, it was erroneously stated that the authors were A. te Wechel, L. Möser, and C. van Aggelen, whereas actually the study was made by J. van Baren, with the co-operation of the three collaborators already named. The writer of the note regrets that Dr. van Baren's name was inadvertently omitted, and welcomes this opportunity of making amends to the senior author of the paper concerned.

Effect of Soil Temperatures on Subterranean Insect Fauna.—An account of experiments on winter soil temperatures at Minnesota and their relation to subterranean insect survival has been given by G. Allen Mail (*Jour. Agric. Res.*, **41**, p. 571). A thermocouple method was used for recording the temperatures at 2-inch intervals for a depth of 2 feet of soil under varying conditions, and although the insulating effect of a snow layer has long been recognised, the differences found between temperatures of snow-covered and bare ground were extraordinarily large. In the case of cleared areas, the soil temperatures showed sharp fluctuations, closely following those of the air, and a spread of 12·48° C. was found between the upper and lower layers investigated. The temperature of the snow-covered soil, however, remained much more constant and showed only a spread of 3·5° C. over the 2 feet depth. From laboratory investigations the freezing-points of adults and larvæ of *Melanotus communis* (a species of wireworm) were found to be − 13° C. and − 15° C. respectively. They would thus be able to withstand Minnesota winter conditions if hibernating below 4 in. from the surface, and experiments where two species of wireworm were buried in outdoor cages at depths ranging from 2 in. to 24 in. supported this view, there being practically no mortality, as the temperatures did not fall below this point. White grubs (chafer larvæ), on the other hand, are much less cold-resistant than wireworms and would have to hibernate at much greater depth, below 2 ft., to overwinter successfully. Climatic conditions, may, therefore, be of great importance in insect control. Since wireworm

larvæ are active only in summer and become dormant in winter, a sudden prolonged drop in temperature would probably prove fatal, as the larvæ might be caught too near the surface of the soil. Further, since rain was found to destroy the temperature gradient between the different layers of soil, a sudden drop in temperature following such conditions might also bring about a high mortality. To some extent, therefore, it might be possible to forecast the severity of wireworm attack according to the previous winter conditions.

Quantum Theory of Nuclei.—In an article in the April number of *Science Progress*, on new aspects of radioactivity, Dr. C. D. Ellis has stated very clearly two β-ray problems which still remain to be explained on the wave-mechanics. The first is that of the distribution of energy amongst the β-particles which arise from the disintegration of the nucleus itself; these have both a continuous 'velocity-spectrum' and an upper limit to the energy which is at best so indefinite that Dr. Ellis concludes that this type of disintegration can occur with an emission of a particle of any energy whatever. The whole process appears to take place in some way governed by essentially statistical laws, as in Maxwell's gas theory, but fundamental difficulties arise in that the corresponding fluctuations must occur within a single nucleus, that is, within a volume comparable with that of the electron when it is considered as a particle, and that the peculiarities of this space must be conditioned largely by the movement of the electron. The second difficulty is that far more energy which could appear in the form of γ-radiation is converted into a corpuscular β-radiation within the parent atom than would be expected. The difficulty persists even when two modes of transfer of energy into the corpuscular type are allowed for, namely, formation of a γ-ray which leaves the nucleus and is converted photoelectrically before it can pass out from amongst the orbital electrons of the same atom, and the assumption of the energy of an excited nucleus, before a γ-ray has been formed at all, as the result of a collision made by one of the orbital electrons of the atom in passing through the nucleus. No satisfactory solution of either of these problems has yet been proposed, and it remains an open question whether or not they are capable of explanation on the present theories.

Pine Resins.—A valuable paper upon the resins of the jack pine (*Pinus Banksiana*) appears in the *Canadian Journal of Research*, **4**, pp. 1-34, 1931, by Harold Hibbert and John Bernard Phillips. The authors examine the methods previously used for the separation of the various constituents from the resin and decide upon a modified procedure in which the resin, originally extracted from the wood by an alcohol-benzene mixture, is extracted with ether, and the water insoluble substances in the ether extract later extracted with 5 per cent sodium carbonate, the residue being then subjected to steam distillation. Resin acids and fatty acids in the alkaline extract are freed by addition of acetic acid, and are then separated by esterification of the fatty acids by ethyl alcohol and sulphuric acid. Steam distillation has yielded a volatile essential oil and a non-volatile residue which is saponified and thus separated into fatty acids and non-saponifiable matter. The resins of fresh and seasoned timber were compared; the changes in the resin during seasoning appear to be due to oxidation and polymerisation of the unsaturated fatty products and to changes in the resin acids. The authors also direct attention to the tendency of the easily polymerisable terpenic products present to yield products of a sticky, tacky nature.

The Quinhydrone Electrode.—The use of the quinhydrone electrode, discovered by Haber and Russ in 1904, has been considerable since its development by Granger and Nelson and by Biilmann, independently, in 1921. The conditions for the reproducibility of the electrode and its value compared with the calomel electrode were published by Biilmann and Jensen in 1927, and now two important papers by Morgan, Lammert, and Campbell have been published in the February issue of the *Journal of the American Chemical Society*, which contain numerous practical details on the use of the quinhydrone electrode. In the first paper, the method of setting up and of cleaning the metal part of the electrode are discussed, and the influence of the nature of the metal used. Platinum and platinum alloys gave better results than gold; the age of the platinum was of little importance if the electrode was large enough. Very small short wires gave erratic results; larger short wires gave consistent results but larger deviations than foils or longer lengths of wire. Two foils with dimensions larger than 1 sq. cm. gave differences of potential, when measured against one another, of less than 0·000010 volt. The second paper deals with the effect of excluding oxygen from the solution and the use of nitrogen in the electrode. Quinhydrone electrodes prepared with nitrogen were found to be far more reproducible than those used in air, and the quinhydrone electrode prepared with chemically pure platinum dipping into 0·1 *N* HCl saturated with quinhydrone and stirred with nitrogen was found to be more easily reproduced with great precision than any other half-cell used for reference. Gold was less satisfactory than platinum. Irregularities in unshorted electrodes, which occur in air, disappear in nitrogen. Whereas cells composed of air-dried electrodes and mechanically-stirred solutions may take an hour to reach equilibrium and unstirred solutions longer, cells with nitrogen-stirred solutions take up equilibrium values almost immediately. The electrodes need not be dried in nitrogen, if this gas is bubbled through the solution.

Hardening of Metals by Rotating Magnetic Fields.—E. G. Herbert has already shown that work-hardened metals become still harder when they are subjected to the influence of a rotating magnetic field. In a recent paper (*Proc. Roy. Soc.*, A. 130, 154) the research is extended to include alloys which are susceptible to age-hardening, and a similar effect has been observed. By the combined use of ageing, magnetic field, and cold work, the hardness of a 0·8 per cent carbon steel has been increased from 715 immediately after hardening to 1080, whilst a high-speed steel has been hardened from 700 to 1000 Brinell. The effects observed are extremely complex, and at times a temporary or permanent softening results. The influence of these alternating magnetic fields is not confined to magnetic materials. Duralumin shows quite analogous effects and the alloy may be 'age-hardened' by magnetic means to a distinctly higher degrec than is normally possible. Even brass shows effects of the order of about six per cent. Although high frequency fields and very rapid rotation of the specimen have been tried, it is shown that neither is necessary, an equally marked effect being produced by slowly rotating the specimen for a few seconds across the poles of a powerful electro-magnet. The temperature at which the treatment is given appears to have considerable influence on the degree of hardening, this being greater for a hard steel at 100° C. than at room temperatures. It is pointed out that the process could be applied with ease to tools such as drills, milling cutters, dies, etc., however complicated their shape.

Cotton-growing in the British Empire.*

THE work undertaken during the year 1929–30 by officers of the Empire Cotton Growing Corporation stationed in the various cotton-producing countries of the Empire is summarised in the report now before us. Following the lines of the similar reports issued in preceding years, with which it requires to be read, the volume is a record of steady progress.

The outstanding feature of the year is the continued success of the Barberton selections of Jassid-resistant strains of cotton. This success is not limited to South Africa, where it has given a new lease of life to an industry threatened with extinction through the depredations of the insect; it extends through a wide tract of country embracing the whole of East Africa as far as Uganda, and even into the Sudan. Though in the latter country U4, the main resistant race, did not show up well under irrigation, of the cottons grown it proved itself one of the most resistant to leaf curl. Being itself a preliminary selection as yet unstabilised in respect of many characters of economic importance, it promises to become, by selection or hybridisation, the parent of numerous strains adapted to one or other of the varied conditions which naturally occur through so wide a stretch of country. In South Africa itself selections from U4 are being crossed with Cambodia, certain selections from which have proved to be even more Jassid-resistant than the original U4.

Of the impressions which a perusal of the various reports leaves on the mind, perhaps the most lasting is concerned with the manner in which local conditions force into prominence different aspects of the problem which the organisation has set itself to solve. In South Africa the primary problem was concerned with Jassid, for on that solution the life of the industry depended. With the solution of that problem, other aspects are assuming prominence. Cotton is here one of a series of crops; it occupies no dominant position. Its setting in the rotation is receiving growing attention, and progress is recorded in the investigation of that interesting problem of the harmful effect of a preceding fallow. In the two Rhodesias, if the work at Barberton has removed one danger and provided in U4 a basis for remunerative cultivation, other dangers exist, and in the cotton stainer and the boll worm the insect world exercises a dominating position. In Nyasaland, soil problems are engaging attention, especially in relation to root development. In Uganda, the varietal question predominates.

In that complex area, the Sudan, the question of staple assumes importance in those areas, like the Gezira, in which the Egyptian type of cotton is grown, and much attention is devoted to spinning tests. The appearance of leaf curl during the last few years has introduced a new threat into these tracts which has to be met within the group of cottons yielding that class of fibre, and here resistant strains of Sea Island afford a promising basis for progress. It is of interest to note the suggestion that this resistance may be the result of a capacity to form an adequate root system, for there is in this suggestion further evidence of a growing recognition of the need both for a better knowledge of root systems in general and for a deeper search for the basis of resistance either in morphological character or in physiological reaction. While there is still much to learn with respect to the transmission of the disease, its development appears to depend in large measure on the capacity of the root system to make use of the particular soil in which the plant is growing.

The potentialities of the rain area in the Southern Sudan are being explored, and the work, as is natural in a country lacking an indigenous system, is mainly concerned with variety trials and dates of sowing. The necessity of early sowing is clearly demonstrated.

* Empire Cotton Growing Corporation. Reports received from Experiment Stations, 1929–30. Pp. xi+342. (London: Empire Cotton Growing Corporation, 1931.) 2*s*. 6*d*.

History of the Fauna and Flora of the British Isles.

THE British Isles, with their comparatively small area but considerably varied natural conditions, present a number of highly interesting biogeographical problems, the solution of which would bear an important relation to the larger problems of the distribution of organisms in Europe and in the northern hemisphere generally. It is not surprising, therefore, that the French Société de Biogéographie should have selected the history of the fauna and flora of the British Isles as a subject for its new volume,* the third of a series devoted each to the treatment of a separate biogeographical problem; the two previous volumes dealt with the biogeography of Corsica and of the high mountains of the world respectively.

The volume represents a collection of papers by ten different authors, writing in French or in English, and each dealing with his special group of organisms in his own way. An introductory article, by L. Joleaud, on the palæogeographical history of the British Isles, is followed by a paper on mammals, by H. Heim de Balsac, who discusses not only the recent fauna, but also summarises the post-glacial palæontological evidence. One of his general conclusions is that the history of the British fauna is in many respects different from that of the European fauna, particularly with regard to the effects of the glacial period, which were considerably less serious in the British Isles owing to their milder oceanic climate. The next article, by the same author, deals with British birds, and emphasises the high percentage amongst them of endemic races, as well as the presence of certain Mediterranean elements.

The spider fauna of the British Isles is analysed by W. S. Bristowe, who divides the country into five zones, limited mainly by temperature conditions. With regard to the history of the spider fauna, Mr. Bristowe believes it to be relatively simple, and appears to derive it directly from the continent after the original fauna had been exterminated by glaciation. A great portion of his article is devoted to the discussion of a general problem of the aerial migration of spiders as a factor in populating island areas.

A full list of British Orthoptera includes only 36 species, 10 of them being introduced through human agency. The affinities, distribution beyond the British Isles and the probable history of each of them, is discussed by B. P. Uvarov. Out of this number, nine species are considered to be relics of a very ancient, probably Tertiary, fauna connected with humid and warm climate. Another definitely preglacial group of five species, distributed mainly in the Mediterranean region, is called Atlantic, and they are regarded as relics of the rich fauna of Atlantis, which continent has probably extended as far northwards

* Contribution à l'étude du peuplement des Iles Britanniques.—Société de Biogéographie, 3, pp. 193. (Paris: P. Lechevalier, 1930.)

as the southern coasts of Ireland and England. One-third of the fauna, twelve species, exhibit affinities with the present-day Siberian and eastern European fauna and are considered to represent the result of an invasion of the steppe fauna, originating in the Angara continent. This invasion may have happened either after the last glaciation or, possibly, immediately before it.

M. E. Mosely presents a survey of British Trichoptera, but abstains from zoogeographical deductions, while stressing the importance of the ecological factors in their distribution.

The Heteropteran fauna is analysed by W. E. China, who recognises in it the Lusitanian, or Atlantic, the American, the Arctic, and the Germanic elements, these being the groups distinguished by Scharff in his well-known work on European animals. Certain members of the Lusitanian group are xerothermic in their ecological requirements, but their present distribution elsewhere makes it highly probable that they have survived through the glacial periods on the spot, in sheltered situations. Most of the species of the American group should be properly referred to the Angara fauna, to which the larger portion of the Germanic group also belongs, but there are species occurring only in America and in western Europe, including the British Isles, but not in Russia or Siberia. Definite relationship to the American fauna is also shown in the Arctic group. Insular variations in British Heteroptera are unimportant and few in number. Out of six endemic species, three are doubtful, while the remaining three are probably Atlantic relics.

A brief review of British Lepidoptera, by L. Dupont, stresses the poverty of the British fauna and the presence of a considerable number of local forms, many of them being melanistic. No zoogeographical analysis is attempted by this author.

A discussion of the beetle fauna, by J. Sainte-Claire Deville, one of the best authorities on the zoogeography of European Coleoptera, is highly interesting and instructive, being illustrated by a series of twenty-four distributional maps. One of the main conclusions of this author is that there are no sufficient reasons to believe that the Quaternary glaciation exterminated the original fauna. On the contrary, a number of species of southern origin (Mediterranean) have certainly survived the glaciation.

The last two articles of the volume deal with the flora. J. Cardot discusses the mosses, and reveals the interesting fact that there is a very close relationship between the bryophyte flora of the British Isles and that of the Atlantic islands (Canaries, Madeira, and Azores). There are even several species which do not occur elsewhere, while certain species occur besides in the subtropics only. The author, however, attributes their appearance in the British Isles to the distribution of spores by air, after the Quaternary glaciation, which in his opinion has wiped out all mosses except some boreal species.

A. J. Wilmott in his thorough analysis of the British phanerogamic flora arrives at the opposite conclusion, which is based on a critical discussion of geological facts and theories, of the evidence derived from the study of the Quaternary fossil plants, and of the present distribution of floristic elements. He believes that the climate of the glacial periods could not have been so severe as to exterminate the original flora completely, and there is every reason to think that the relatively mild and humid climate of Atlantic type prevailed at least in some sheltered situations of the south-west of Ireland and England, thus permitting the survival of aboriginal plants. As we have seen, this conclusion agrees well with the opinions of the majority of the contributors to this interesting volume.

The Name of Mount Everest.

MOUNT EVEREST was first observed by the Survey of India in 1849, but it was not until three years later that its great height was realised. From the plains of India it is only one among many conspicuous peaks, and its distance from the Indian frontier across the whole width of Nepal often prevents its being seen at all. In these circumstances, it was not surprising to find that there was no Indian name for the peak. The first names proposed were the Nepalese names Devadhunga and Gaurisankar. The first, however, was found to be non-existent as a peak name in Nepal, and the second belongs to another peak. There was no entry of the surveyors into Tibet in those days, and, in the lack of Indian and Nepalese names, it was necessary to find a title for the peak. This was done in 1865 by naming it after Sir George Everest, of the Trigonometrical Survey of India.

The controversy about the name was discussed by Major S. G. Burrard in NATURE,[1] and is now reopened by Dr. Sven Hedin in his recent German book on Mount Everest. Sir Sidney Burrard replies to these suggestions in a paper recently issued by the Survey of India.[2] Dr. Hedin maintains that the mountain was first shown on D'Anville's map of Tibet published in Paris in 1733. This was based on a survey made between 1711 and 1717 by Chinese lamas instructed by Jesuits in Peking, and was until about a century ago the only map of Tibet. The identification of Mount Everest on this map is very doubtful. A range of great heights is shown at right angles to the actual alignment of the peaks of the region. Located in terms of the river valleys, which the lamas portrayed more accurately than the mountains, this range is forty miles distant from Mount Everest. Moreover, there is no indication that the lamas were aware of an exceptionally high peak in that region. Thus, there are no grounds for using the lamas' name of Chomo Lungma for Mount Everest, as Dr. Hedin suggests.

Attempts to discover a Tibetan name for the mountain have resulted in five names being found. Each has merely local use and not one has any general acceptance although the mountain is a conspicuous feature from several parts of Tibet. One of these names is certainly Chomo Lungma, but it would appear to have restricted use and to be applied to both Everest and Makalu: in fact, it is applied to an area rather than a peak.

In these circumstances, there is no justification for displacing the name of Everest. It has always been the practice of the Survey of India to use local names when these have been in existence. Everest is probably the only departure from this principle, but it is a departure that was unavoidable. Even if a Tibetan name in general use were revealed, it would be of doubtful value to replace a name that has now become universally known and accepted. No possible benefit could result from such a change.

[1] NATURE, Nov. 10, 1904.

[2] Survey of India. Professional Paper No. 26: Mount Everest and its Tibetan Names; a Review of Sir Sven Hedin's Book. By Col. Sir Sidney Burrard. Pp. ii+18. (Dehra Dun: Survey of India, 1931.) 8 annas; 10*d*.

Research at the Mellon Institute during 1930-31.

IN his eighteenth annual report to the board of trustees of the Mellon Institute, Pittsburgh, the director, Dr. E. R. Weidlein, has summarised the activities of the institution during the fiscal year ended Feb. 28, 1931. The sum of about £160,000 was contributed to the Institute by the industrial fellowship donors in support of scientific research. The total amount of money appropriated by companies and associations to the Institute for the twenty years ended Feb. 28, 1931, was £1,511,000.

Throughout the entire fiscal year 76 industrial fellowships—22 multiple fellowships and 54 individual fellowships—were in operation. During the preceding year the number of fellowships was 71. In 1930–31, 140 industrial fellows and 49 assistants held positions on the research staff. Sixty-four industrial fellowships (17 multiple fellowships and 47 individual fellowships)—three more than on Feb. 28, 1930—were active at the close of the fiscal year. Nine fellowships are being sustained by industrial associations. The industrial research personnel consists of 109 fellows and 31 assistants. Thirty-one fellowships have been in operation for five years or more, and of this number 18 have concluded more than ten years of work. Three (and possibly four) new fellowships will begin operation during the early part of the present fiscal year, as soon as laboratory space is available.

According to the report, noteworthy results have developed from the following fellowships: air pollution, by-product coke, face brick, fertiliser, heat-insulation, iodine, nitrogenous resins, organic synthesis, refractories, sleep, and utensil. Twelve fellowships completed their research programmes, namely: chrome ore, insulating lumber, Portland cement, composite glass, yeast, inhibitor, steel treatment, rock products, roofing, fatty acids (uses), oxygen, and face brick. Thirteen new fellowships were added to the Institute's roll during the fiscal year, as follows: safety fuse, plastic composition, bread, cottonseed products, hydro-engineering, abrasives, newsprint, fatty acids (synthesis), shoes, optical glass, commodity standards, and tyre bead.

The Department of Research in Pure Chemistry had a productive year and two fellows were added to the staff. Twenty-two investigational reports have been published since the establishment of this department in 1924. Among the subjects that are receiving research attention are the chemistry of marine plants, cherry gum, gum arabic and quince-seed mucilage, and the properties of the sugar acids.

The publications by members of the Institute during the calendar year 1930 included 1 book, 5 bulletins, 45 research reports, and 44 other papers. Sixteen U.S. patents and 13 foreign patents were issued to fellowship incumbents. The total contributions to the literature for the 19 years ended Jan. 1, 1931, have been as follows: 16 books, 101 bulletins, 573 research reports, 893 other articles, and 423 U.S. patents. These publications are listed in the Institute's *Bibliographic Bulletin* No. 2 and its four supplements.

The commencement of the construction of the Institute's new home is referred to as the most important event during the year covered by the report. Early in May 1930 it was decided that, as the present two buildings of the institution are inadequate for the immediate and future needs of its departments and industrial fellowships, a commodious modern structure would be built at the corner of Fifth and Bellefield Avenues, Pittsburgh. The excavating work, which was begun on Nov. 5, was finished in March and the foundation is now being constructed.

The new building, which will be completed in about two years, will enable the Institute to expand greatly its research facilities and activities in both pure and applied acience. The structure, which will be in the Ionic style, will be built of granite and Indiana limestone; it will be plain but massive, and will be surrounded by 62 monolithic columns. The proportions of the building will be approximately 300 ft. by 275 ft., and there will be eight working floors.

Hydrography of Polar Seas.

IN the journal of the International Council for the Exploration of the Sea, for December 1930 (*Journal du Conseil*, vol. 5. No. 3, p. 329), E. Kreps and N. Verjbinskaya of the Murman Marine Biological Station describe the results obtained on cruises made in the months of March, May, September, and December along the meridians 33° 30′ E. and 38° E. from the Murman shore to the ice margin. The waters showed the typical cycle of the utilisation of phosphates and nitrates by the phytoplankton in the spring and summer months and their regeneration in the winter. The phytoplankton was, in this research, estimated by centrifuging an aliquot part of sea water, dissolving the contained diatoms in alcohol, and determining the amount of chlorophyll present spectro-photometrically.

The region under survey is invaded by branches of the North Cape current of warm Atlantic drift water, the southernmost branch being the Murman current, and the Franz-Joseph branch being in the north. An interesting difference between the cycle of events in the cold polar waters and that in the warmer Atlantic water was brought out. In May, in the cold Arctic waters, an outburst of diatom flowering had already taken place and the surface waters down to 25 metres showed a decrease in their manurial salt content; the Atlantic water, however, showed little difference in its content of these salts from the surface to the bottom and there was as yet no sign of diatom growth. In September, there was little difference between the Arctic and Atlantic waters, the surface layers all being depleted in phosphate and nitrate and the deeper layers rich; but the conditions of phytoplankton production were reversed, the Atlantic surface waters being now rich in chlorophyll and the Arctic waters very poor.

It thus seems that the outburst of phytoplankton in the Atlantic water takes place later than in the Arctic waters. The actual reasons for this afford an interesting problem. In winter, complete vertical mixing had taken place and the phosphates and nitrates had been enriched from the surface downwards. In 1930, observations made between March 28 and April 11 showed no sign of the vernal outburst in the Arctic waters.

With reference to the relative richness in nutrient salts, the inshore waters were the poorest, the Arctic waters the richest, the Atlantic water being not so rich as the cold. The maximum winter values for phosphates were in the neighbourhood of 50-60 mgm. P_2O_5 per cubic metre. In the same journal it is also interesting to read of phosphate estimations made in southern polar seas by Johan T. Ruud (*ibid.*, p. 347); here in places in the Weddell Sea the readings run up to 150 mgm. P_2O_5 per cubic metre at the surface.

University and Educational Intelligence.

CAMBRIDGE.—An election to the Sheepshanks Exhibition for proficiency in astronomy will be held in the present term. Any member of the University under the standing of master of arts or, being a research student, under the standing of doctor of philosophy may be a candidate for the exhibition. The holder of the exhibition is required to engage in astronomical research to the satisfaction of the Council of Trinity College. Candidates are invited to send in their applications, before May 6, to Prof. Stratton, Gonville and Caius College, stating their qualifications and claims and proposed course of astronomical research.

The General Board recommends (*a*) that a university lectureship in pharmacology be established in the faculty of medicine as from Oct. 1, 1930; (*b*) that a university demonstratorship be established in the Department of Experimental Psychology as from Oct. 1, 1931.

The following Syndicate has been appointed to consider the medical courses and examinations of the University and their relations to courses and examinations for the degree of B.A.: the Vice-Chancellor, Prof. H. R. Dean, Mr. W. Spens, Sir Humphry Rolleston, Dr. T. S. Hele, Dr. E. D. Adrian, Dr. A. E. Clark-Kennedy, Dr. L. A. Borradaile, Prof. J. T. Wilson, Prof. J. Barcroft, Mr. H. Thirkill, and Mr. H. McCombie.

EDINBURGH.—Members of the University Court, Senatus, and General Council and a large body of students attended on April 22, in the Old College, a memorial service to the late Prof. Lorrain Smith, professor of pathology since 1912 and dean of the faculty of medicine. The service was conducted by the dean of the faculty of divinity, Prof. Curtis; the text was read by the Vice-Chancellor, Sir Thomas Holland; and Prof. Samuel Alexander, of the University of Manchester, paid a tribute to the memory of Prof. Lorrain Smith. Representatives attended from the Universities of Belfast, Manchester, Cambridge, Glasgow, and Aberdeen.

LONDON.—Keddey Fletcher-Warr Studentships, each of the value of £250 a year for three years, have been awarded to Mr. H. W. Thompson, for a study of the chemistry of the methyl- and the chloro-naphthalines, and to Margaret Hill, for the continuation of work in progress on the regulation of the ovary, with special reference to the part played by the hormones of the anterior pituitary body.

THE fourth biennial conference of the World Federation of Education Associations will be held at Denver, Colorado, on July 27–Aug. 2. Of special interest is the health section, which is active in promoting the health of children through the schools of the world. Further information concerning the conference can be obtained from Miss S. L. Jean, 200 Fifth Avenue, New York.

AN election will shortly be made to a Bayliss-Starling Memorial Scholarship, founded by old students, friends, and admirers, in commemoration of Sir William Bayliss and Prof. E. H. Starling. The scholar will be required to follow a course of study approved by the Jodrell professor of physiology at University College, London, involving a training in the principles of, and methods of research in, physiology and biochemistry. Candidates must send their applications to the Secretary of University College not later than Friday, May 15.

A PARTY of representatives of the universities of Great Britain were the guests of the Prussian Government on April 19, at the State Opera House, Berlin. The party has been on a tour of investigation of the German university system. The tour was organised at the instance of the International Relations Committee of the Association of University Teachers. It is the second international tour that has been organised, the first having been to France in 1930. The objects in view are to collect data for a comparative study of university systems and to promote contact and co-operation between academic circles in Great Britain and other countries. Visits to Switzerland and the United States of America are in contemplation. Both in France and in Germany these visits have aroused wide and intense interest among education authorities, who have received the parties with the greatest cordiality and have offered the fullest facilities for inquiry into every aspect of their activities. There can be little doubt that in publishing detailed reports of these investigations, the Association of University Teachers is performing an important service both to the cause of higher education, especially in regard to university development, and in furthering international understanding and goodwill, and that it may eventually result in the establishment of some permanent scheme of co-operation on the part of the universities of the world, which may create a forum for the discussion of their common problems. The Report on the French University System, based on the 1930 visit to France, may be obtained from Prof. R. Douglas Laurie, honorary general secretary of the Association of University Teachers, University College, Aberystwyth (6*d*.).

Birthdays and Research Centres.

May 3, 1892.—Prof. G. P. THOMSON, F.R.S., professor of physics in the Imperial College of Science and Technology.

An attempt is being made by several workers at the Imperial College to use the phenomenon of electron diffraction as a tool to study the nature of surface layers, particularly those formed in the corrosion of metals. It has been proved that cathode rays, when reflected from a crystalline or microcrystalline surface of known structure, form a diffraction pattern which depends on the crystal structure just like the pattern formed by X-rays. Conversely, the pattern gives information about an unknown structure. The advantage of using electrons instead of X-rays is that the former only penetrate a few molecules deep, and so give information about the surface layer without confusion by the bulk of the solid.

May 7, 1886.—Prof. H. HARTRIDGE, F.R.S., professor of physiology at St. Bartholomew's Hospital Medical College, London.

In conjunction with Dr. Ranyard West, I have been engaged on an investigation of certain aspects of muscular tone. We have found that tetany, produced in animals by the removal of the parathyroid glands, may be temporarily relieved by the administration of the drug curare. Before giving the curare, an animal may be lying on its side with its limb muscles in tonic contraction; about half an hour after giving the curare, the animal may be running or eating in apparent normal health.

Since curare is used as an arrow-head poison, for producing paralysis and death, this 'cure' of tetany is a very unexpected phenomenon. We are investigating the matter further, as we hope it may throw light not only on the mode of action of curare, but also on the nature of tetany.

Societies and Academies.

LONDON.

Geological Society, April 1.—**Bernard Smith**: The glacier-lakes of Eskdale, Miterdale, and Wasdale, Cumberland; and the retreat of the ice during the 'Main Glaciation'. From a review of the available evidence in the north-west of England it is concluded that the Great Ice Age in Cumberland and the Irish Sea basin comprised at least three main episodes. This paper is confined chiefly to the second—that of the 'Main Glaciation'. The withdrawal of the combined Irish Sea and Lake District ice towards the close of this episode is discussed, and it is concluded that the split between the two ice-sheets progressed northwards, Irish Sea ice tending to shrink on one hand towards the sea-basin westward and north-westward, whilst the Lake District ice—breaking up into tongues or local glaciers—tended to shrink north-eastward and eastward. The stages in the formation of the lakes and their deposits are described, and the positions of the ice-fronts at different times are indicated. Of the deposits, special reference is drawn to beaches, especially those fringing islands, to normal lake-deltas, and to a variety referred to as 'scale-deltas'.—**Rev. Joseph Fowler**: The 'one-hundred foot' raised beach between Arundel and Chichester. Prestwich, in 1858, assumed that the 15-foot raised beach at Brighton is represented by the 100-foot raised beach west of Arundel. Clement Reid seems to accept this identification. There is, however, no proof, either of (1) any differential movement in the general process of elevation, or (2) a fault between the two series that might account for the discrepancy in levels. Moreover, the 'rounded shingle', cited by Prestwich as connecting the two series of marine material, is almost certainly of Tertiary age. It seems safer to assume the presence of two stages of raised beach—a '100-foot' and a '15-foot' beach. Clement Reid appears really to support this view when he is considering the different ages of the Selsey deposits. So also, more recently, does H. J. O. White. Nevertheless, it must be noticed that there is, apparently, no ascertained example of the 100-foot beach east, or of the 15-foot west, of the Arun Valley.

Royal Meteorological Society, April 15.—**W. D. Flower**: An analysis of the cold front over Egypt on Mar. 7, 1929. The usual autographic records of wind, temperature, humidity, and pressure at Heliopolis and Ismailia were used, with records of the vertical temperature gradient at the latter station. The cold air advanced in the form of a wedge with its nose above the surface of Ismailia, but as a flat wedge on the surface at Heliopolis.—**W. H. Pick**: A note on the relationship between fog and relative humidity. The fogs occurring at synoptic hours at Cardington during the years 1929 and 1930 are examined and it is shown that the majority of them were accompanied by unsaturated air, as determined by readings of the dry and wet bulb thermometers. This concurrent occurrence of unsaturated air is independent of the intensity of the fog, even the majority of the very thick fogs being so accompanied.—**H. Jameson**: Temperature observations on Adam's Peak, Ceylon. Observations of temperature made at the summit of Adam's Peak, Ceylon, altitude 7360 feet, on twenty-three days in January and February 1930, are discussed and compared with simultaneous observations at Nuwara Eliya, a valley station at 6170 feet. The night temperatures showed the normal differences between a valley and a peak site. During the day, however, there was a sharp rise of temperature in the morning, lasting until about 11 A.M., and giving much higher temperatures than might be expected at that altitude. This was followed by a steady fall, until the constant night temperature was reached about 6 P.M. These day temperatures were probably due to mountain winds converging up the Peak in the morning, and forming cloud over it before midday.—**S. P. Wiltshire**: The correlation of weather conditions with outbreaks of potato blight. The present investigation has been carried out to see if the correlation established by Dutch workers between the weather and blight outbreaks holds good in England, and the results obtained indicate that while the requisite conditions occur more or less regularly before outbreaks, such conditions are not invariably followed by attacks of the disease. The fact that outbreaks do not usually occur without the weather requirements being fulfilled, though negative in character, appears to be of value in practice, and in the intensive seed potato growing area of Friesland, where as many as ten sprays may be applied in a year, the service has enabled the grower to wait with some degree of safety for appropriate weather conditions before spraying.

PARIS.

Academy of Sciences, Mar. 16.—**L. Cayeux**: The epigenic origin of the Jurassic dolomites of the Pyrenees. The formation of these dolomites is a case of the general problem of the dolomitisation of a limestone.—**H. Vincent** and **L. Velluz**: The cryptotoxic properties of the halogen substituted oxybenzoic acids. The results of a systematic study of the cryptotoxic properties of the chlorine, bromine, and iodine derivations of salicylic acid. Salicylic acid is from two to three times as active as its isomers, and sodium diiodosalicylate possesses 280 times the cryptotoxic activity of sodium salicylate: it also possesses antiseptic properties.—**C. de La Vallée Poussin**: Some extensions of the method of *balayage* of Poincaré and on the problem of Dirichlet.—**E. Mathias**: The existence or non-existence of lightning *en chapelet*.—Thomas Hunt Morgan was elected *correspondant* for the Section of Anatomy and Zoology.—**Arnaud Denjoy**: Riemann's hypothesis on the distribution of the zeros of $\xi(s)$, related to the theory of probabilities.—**Paul Lévy**: Some theorems on enumerable probabilities.—**G. Pfeiffer**: The construction of the general operator permuting the intervals of a linear and homogeneous partial differential equation of the first order.—**E. Kogbetliantz**: The summability (C, δ) of developments according to Hermite polynomials.—**Henri Mineur**: The dynamics of variable masses according to the laws of Newton and of Einstein.—**Mme. E. Chandon**: The mean depth of a canal calculated by means of the harmonic constants of two stations.—**E. Fichot**: Remarks on the preceding communication.—**L. Brillouin**.—Elasticity, thermal agitation, and fusion of solids.—**Paul Ansiau**: The realisation of a mercury vapour pump. Description of construction, with a diagram, mode of working, and performance of a mercury vapour pump.—**Pierre Auger** and **Mlle. Thérèse Meyer**: The directions of emission of photoelectrons. Experiments have been carried out with the Ka radiation of uranium, and the results compared with calculations based on Sommerfeld's theory.—**Mlle. M. Chenot**: The phenomena of propagation in ionised gases by discharges of very high frequency.—**Constantin Salceanu**: The magnetic rotatory polarisation of some higher homologues of the organic fatty acids. The acids studied were decanoic, lauric, myristic, palmitic, and stearic. Perkin's rule is only true as a first approximation, as systematic differences appear for the higher terms.—**Pierre Montagne**: The application of a square

diagram to the representation and calculation of the equilibrium in the water gas reaction.—R. Wurmser and J. Geloso: The oxido-reduction potential of solutions of glucose.—L. Bull and Mlle. Suzanne Veil: The kinetic study of Liesegang's rings.—Picon: Pure cerium sulphide. Sterba's method, the interaction of cerium oxide and hydrogen sulphide at a high temperature, gives a product free from oxygen provided the temperature is 1500°-1600° C. At 1000° C. the sulphide still contains 2 per cent of oxygen. The pure sulphide melts at 2200° C. and is stable at the melting point. The reaction with carbon dioxide at 700° C. is unusual, $Ce_2S_3 + 4CO_2 = 2CeO_2 + 4CO + 3S$.—M. Bourguel: The formation of an intermediate form in an acetylene transposition. The prolonged action of sodium amide at 60°-70° C. upon $C_6H_5.C\equiv C.CH_3$ gives a sodium derivative, from which treatment with dilute acid gives $C_6H_5.CH_2.C\equiv CH$ and an isomer which does not react with ammoniacal cuprous chloride. This isomer absorbs oxygen giving $C_6H_5.CO.CO.CH_3$, and its composition is undetermined.—Henri Termier: The discordances of the meso- and cenozoic series in Central Morocco and the Middle Atlas.—L. Eblé and J. Itié: The values of the magnetic elements at the Val-Joyeux station (Seine-et-Oise) on Jan. 1, 1931. The only special point is the clear increase in the vertical component. This has now the same value as it had on Jan. 1, 1911, after having undergone in the twenty-year interval an oscillation characterised by a relative maximum in 1918 and two minima in 1915 and 1926.—N. P. Péntcheff: The proportion of krypton and xenon in some Bulgarian natural gases. The spectrophotometric method of Moureu and Lepape was used in these determinations. The results are in agreement with the astrophysical theory of Moureu and Lepape.—Kalé: Contribution to the morphological study of the stem of *Triticum vulgare*.—P. Vignon: The teeth of the labrum of certain gasteropods with turbinated shell, and the relations which they may develop with the varices.—Mlle. Odette Tuzet: The parabasal apparatus and the dictyosomes in *Reniera simulans* and *Hymeniacidon sanguinea*.—Maurice Piettre and Boris Celan: The rôle of the different cellular elements in the mobilisation of the lipoids in the mammary gland; Donné's corpuscle.—Maurice Lecamp: Experimental duplications of the posterior limbs in the toad *Alytes obstetricans*.—Ch. Joyeux and J. Pieri: The hibernation of the virus of Mediterranean exanthematic fever. It is proved that *Rhipicephalus sanguineus* can harbour the virus of this fever during the winter, or for at least the first part of the winter. There are indications that the virus is attenuated by this hibernation.

GENEVA.

Society of Physics and Natural History, Nov. 20.—Arnold Pictet: The existence of two markings in guinea-pigs, one dominant, the other recessive. In guinea-pigs, the marking of the body is dominant in the monohybrid of uniform coloration, whilst the marking of the extremities is simply recessive. These two monohybrid systems fit into each other to form a dihybrid system, so that the heredity relations between the uniform fur and the two kinds of markings are governed by a double pair of inheritance factors.—E. Bovier: The ammonites of the upper Sinemurian of Champfromier (French Jura). The author gives a list of the ammonites from the Lias which he has collected at Champfromier. From these the presence of the three following Oppel zones is inferred: *Echioceras raricostatum* zone, *Oxynoticeras oxynotum* zone, and *Asteroceras obtusum* zone. He then points out the differences observed between the sections of British authors and his results, as well as the slight value to be attached to the stratigraphy in 'hemeræ' of the late S. S. Buckman.—Henry Goudet: The optical activity of certain anthracene derivatives. By the reduction of benzyloxanthrone-β-carboxylic acid ($[\alpha]_D^{20} = -71{\cdot}6°$) an optically inactive γ-benzyl-anthracene-β-carboxylic acid is obtained. This fact tends to prove the non-existence of a medial linkage between the atoms of carbon 9 and 10 of the anthracene. Its value as a crucial test, however, is diminished by the fact that the inactivity of the γ-benzyl-anthracene-β-carboxylic acid thus obtained might not be due to the constitution of the acid itself, but to a racemisation produced during the reduction.—R. Wavre: The axes connected with a fluid and criteria of stability. The author shows at the start that the central axes of inertia and the axes connected to the equivalent solids must be distinguished. He then points out a general criterion of stability of a relative equilibrium, from which he deduces as particular cases the criteria of Poincaré and Kelvin. This general method will be developed in a work on the whole question.—G. Tiercy: The dimensions of the terrestrial spheroid. The author notes that the value for the terrestrial flattening, 1/294, takes account, to the second approximation, of all known measurements, whether geodetic, precessional or of the mean superficial density of the earth. The author adopts this value although the geodetic institutes admit others, about 1/297. Taking all known measurements into account, he derives the following values for the axes of the terrestrial spheroid;

Semi-major axis = 6378·250 kilometres.
Semi-minor axis = 6356·555 kilometres.

Dec. 4.—Jean Weiglé: The work of removing electrons. The work which must be supplied to tear off an electron from a metal is due, at least in part, to the electrostatic attraction of the metal on this electron. This problem is treated by the method of images and the force thus calculated is called the force of the image. The author has studied these forces when the metal is surrounded: (1) by an infinite dielectric, and (2) by a dielectric layer. He has also considered the theory of images in dielectrics from a general point of view. These theoretical results may be submitted to various experimental proofs suggested by the author.—Paul Rossier: The index of absolute colour and stellar statistics. This study comprises the calculation of the difference, visual magnitude of a star minus the bolometric magnitude: properties of the minimum of the difference. The application to the eye appears to be fairly exact, especially for hot stars. The proportion of hot stars is higher than that given by visual observations. A difficulty in Russell's evolution theory is thus eliminated.—Charles Jung: The albumin and globulin of the blood serum. The author's experiments appear to prove that precipitation by sodium sulphate in solution gradually increasing in concentration gives globulins in which the nitrogen percentage also increases. The fraction precipitated with the proportion 21·5 per cent differs little from that precipitated by carbon dioxide, according to the technique employed. The average nitrogen percentage of the total globulins is 14·8 per cent, which would lead to the factor 6·75 when determining by nitrogen, admitting that the proportion of englobulin and the pseudo-globulins varies but slightly.—E. Galfre: The study of some electrochemical phenomena in metallic osteosynthesis. As a result of various researches on osteosynthesis, the author has arrived at the conception that it is electrolytic phenomena which preponderate in operating failures. Working with various pieces of prothesis

fixed in the bone, he has measured very substantial potential differences, varying between 150 and 350 millivolts. The conductivity of bone is fairly high. On the other hand, micro-determinations of the calcium set free by the presence of plates show figures of the order of 5 mgm. in 8 days. This proves the danger of couples. These couples do not even require a bimetallic material, but may be produced with a single metal.

Official Publications Received.

BRITISH.

Tanganyika Territory: Department of Agriculture. Annual Report 1929-30. Part 1: Agricultural Administration and Progress. Pp. ii+37. 2s. Part 2: Agricultural Investigation. Pp. ii+49. 2s. (Dar es Salaam: Government Printer.)

Geological Survey Department: Tanganyika Territory. Short Paper No. 7: Notes on the Mineral Deposits in the Newala-Lindi Area. By G. M. Stockley; with Petrological and Mineralogical Notes on certain Associated Rocks, by Frank Oates. Pp. ii+34. (Dar es Salaam: Government Printer.)

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 11: Revisions of Indian Fossil Plants. Part 2: Coniferales (b. Petrifactions). By Dr. B. Sahni. Pp. 47-124+plates 7-15. (Calcutta: Government of India Central Publication Branch.) 7.6 rupees; 12s.

Transactions of the Geological Society of South Africa. Vol. 33, January to December 1930. Pp. iv+134+3 plates. 42s. Proceedings of the Geological Society of South Africa: containing the Minutes of Meetings and the Discussions on Papers read during 1930. To accompany Vol. 33 of the Transactions. Pp. iii+lxvi. (Johannesburg.)

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1930. Pp. 13. (Salisbury.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 93: Prickly Pear and its Eradication. By C. R. van der Merwe. (Division of Chemistry, Series No. 107.) Pp. 32. (Pretoria: Government Printing Office.) 3d.

Southern Rhodesia: Geological Survey. Bulletin No. 10: The Geology of the Country West of Mount Darwin. By B. Lightfoot and R. Tyndale-Biscoe. Pp. 54+6 plates. (Salisbury.) 2s. 9d.

The Annual Report of the Visitors of the Royal Institution of Great Britain for the Year ending December 31st, 1930. Pp. 21. (London.)

Transactions and Proceedings of the Perthshire Society of Natural Science. Vol. 9, Part 1, 1929-30. Pp. 34+xiv+11 plates. (Perth.)

FOREIGN.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 172: First-Order Leveling in New Jersey. By Howard S. Rappleye. Pp. 35+2 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Field Museum of Natural History. Report Series, Vol. 8, No. 2: Annual Report of the Director to the Board of Trustees for the Year 1930. (Publication 287.) Pp. 267-522+plates 21-40. (Chicago.)

Bulletin of the American Museum of Natural History. Vol. 59, Art. 6: Metacheiromys and the Edentata. By George Gaylord Simpson. Pp. 295-381. (New York City.)

Review of Legal Education in the United States and Canada for the Year 1930. By Alfred Z. Reed. Pp. iii+67. (New York: The Carnegie Foundation for the Advancement of Teaching.) Free.

Cornell University Agricultural Experiment Station. Bulletin 515 Some Shade-Tree Pests and their Control. By Glenn W. Herrick. Pp. 26. (Ithaca, N.Y.)

CATALOGUES.

Essentials in Photography. Pp. 12. (London: Burroughs Wellcome and Co.)

Memorandum on the Hilger Interferometers. Pp. 14. (London: Adam Hilger, Ltd.)

The Nickel Bulletin. Vol. 4, No. 4, April. Pp. 93-124. (London: The Mond Nickel Co., Ltd.)

Leitz Large Metallographic Microscope MM. Pp. 28. Leitz Workshop Material Testing Microscope. Pp. 12. Leitz Appliances for the Preparation of Metallurgical Specimens. Pp. 8. (London: E. Leitz.)

A Catalogue of Book Bargains. (No. 526.) Pp. 16. (London: William Glaisher, Ltd.)

Diary of Societies.

FRIDAY, MAY 1.

CERAMIC SOCIETY (Building Materials Section) (at Imperial College of Science and Technology), at 10.30 A.M.—M. Barrett: Night Architecture.—W. A. McIntyre: Durability of Terra Cotta with Particular Reference to the Filling of Blocks.—M. Barrett: Stock Terra Cotta.—M. Barrett: Metallised Terra Cotta.—At 2.30.—E. R. F. Cole: Kiln Products in Architecture.—G. Haworth: Informal Talk on Modern Machinery Used in Three Processes of Brick-making, *i.e.* Semi-plastic, Stiff-plastic, and Plastic Wire-Cut.—W. Emery: Notes on the Firing of a Blue Brick Oven.

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting), at 10.30 A.M.—Dr. Schmaltz: The Physical Phenomena Occurring in the Semi-circular Canals during Rotatory and Thermic Stimulation.—Dr. H. W. Barber: Eruptions Involving the External Auditory Meatus.—Discussion: Non-malignant Diseases of the External Ear and Auditory Meatus.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Dr. G. M. B. Dobson: Variations and Distribution of Atmospheric Ozone.

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Annual General Meeting), at 4.30.—Prof. G. Portmann: A Big Tumour of the Deep Regions of the Face Removed by Operation, with Cure.—Dr. A. Brown Kelly, Dr. D. R. Paterson, and others: Discussion on Obstruction at the Upper End of the Œsophagus (Excluding Pharyngeal Diverticula).

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof. J. E. Lennard-Jones: Cohesion (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—Annual Meeting.

ROYAL SANITARY INSTITUTE (at Town Hall, Batley), at 5.—Councillor H. Crothers and Councillor H. S. Houldsworth: Housing, with Special Reference to the Housing Act, 1930, from the Aspect of a Town Councillor.—Dr. T. Gibson and H. Hornby: Housing, with Special Reference to the Housing Act, 1930, from the Administrative Standpoint.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at Royal Society of Arts), at 6.—Miss S. Bevington: The Causes of Juvenile Drifting.—A. H. Seymour: *Personnel* Work in Modern Industry.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Prof. W. M. Thornton: High-Voltage Precision Measurements (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. Harrison and others: Discussion on Selling Engineering Products.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Prof. P. G. H. Boswell: The Glacial Deposit of East Anglia, with Especial Reference to the Industries of Early Man.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. D'Arcy W. Thompson: Charlotte Brontë in Brussels.

SATURDAY, MAY 2.

ROYAL SANITARY INSTITUTE (at Town Hall, Batley), at 10 A.M.—Major D. S. Rabagliati and others: Discussion on The Practical Value of Meat Inspection.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District Meeting) (at Chelmsford), at 11.30 A.M.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (at Cambridge).

MONDAY, MAY 4.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—L. R. Cox: A Contribution to the Molluscan Fauna of the Laki and Basal Khirthar Groups of the Indian Eocene.—Dr. H. Boschma: On the Identity of *Sacculina triangularis* and *Sacculina inflata*.—Dr. S. Williams: An Analysis of the Vegetative Organs of *Selaginella grandis*, Moore, together with some Observations on Abnormalities and Experimental Results.—Prof. L. M. Milne-Thomson: On the Operational Solution of the Homogeneous Linear Equation of Finite Differences by Generalised Continued Fractions.—Dr. A. C. Aitken: Further Numerical Studies in Algebraic Equations and Matrices.—Dr. D. Meksyn: Electromagnetic Phenomena in a Uniform Gravitational Field.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. A. H. Finn: Types in Scripture.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Human Monsters and Malformations (1): The Light which Experimental Embryology has thrown on Monstrous Births.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—A. M. A. Struben: Hoof Dams.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Miss M. Mactaggart: Four Cases Illustrating the Technique of Remedial Teaching.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (Annual General Meeting) (at Chemical Society), at 8.—Prof. W. A. Bone: The Constitution of Coal.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—C. P. Skrine: The Highlands of Persian Baluchistan.

TUESDAY, MAY 5.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Sir Arthur W. Hill: Recent Research Work in South and East Africa.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Annual General Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Thomas Stanton: James Forrest Lecture.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—W. P. Rowe: Maori Art.

WEDNESDAY, MAY 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Free State District Meeting) (at 35 Dawson Street, Dublin), at 10.30 A.M.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section) (Annual General Meeting), at 5.—Dr. G. C. Peachey: Thomas Trapham, Cromwell's Surgeon, and others.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Human Monsters and Malformations (2): Monsters which result from an Imperfect Separation of Twin Embryos. A Review of the Various Types which are thus produced.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. C. A. Matley: The Geology of the Country around Mynydd Rhiw and Sarn, South-Western Lleyn (Carnarvonshire).—Dr. E. Greenly and Prof. P. G. H. Boswell: An Ordovician Grit from Anglesey, with its Bearing on Palæogeography and upon the Tectonics of the Mona Complex.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—C. O. Browne and others: Informal Discussion on Technical Problems in Connexion with Television.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—E. J. Guild: Demonstration of a New Development in Filter Papers.—A. J. Amos and Dr. D. W. Kent-Jones: The "Rope" Spore Content of Flour and its Significance.—Dr. W. R. Schoeller and H. W. Webb: The Separation of Tin from Tantalum and Niobium.—N. L. Allport: A New Method for Detecting Decomposition Products in Anæsthetic Chloroform.—J. N. Rakshit: Contaminations in Morphine deposited in the British Pharmacopœia Process for the Analysis of Opium.

ROYAL SOCIETY OF ARTS, at 8.—Major-Genl. Sir Fabian Ware: The Preservation of the Country-side.

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8.—W. B. Woodhouse: Progress of Power Production (Annual May Lecture).

ROYAL SOCIETY OF MEDICINE (Surgery Section) (Annual General Meeting), at 8.30.—A. J. Walton, G. Gordon-Taylor, and others: Discussion on The Surgical Treatment of Simple Ulcers of the Body of the Stomach.

ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at House of B.M.A.).

THURSDAY, MAY 7.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Free State District Meeting) (at 35 Dawson Street, Dublin), at 10.30 A.M.

ROYAL DUBLIN SOCIETY (at Ball's Bridge, Dublin), at 2.—R. Borlase Matthews: Electricity on the Farm.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—M. D. Waller: (*a*) The Measurement of Actinic Erythema produced by Ultra-violet Radiation with special reference to the Latent Time; (*b*) The Relation between Energy Doses of Ultra-violet Radiation and Actinic Erythema produced.—J. W. Tudor Thomas: On the Relation of Sensitiveness in Corneal Grafts in Rabbits.—G. E. Briggs and A. H. K. Petrie: Respiration as a Factor in the Ionic Equilibria between Plant Tissues and External Solutions.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss E. Stevinson: The Nursery School.—Mrs. Jessie White: The Nursery Class as it might be.

CHEMICAL SOCIETY, at 8.—Miss R. E. J. Marler and E. E. Turner: Orientation Effects in the Diphenyl Series. Part IX. The Nitration of 4-chloro-4′-fluoro- and 4-bromo-4′-fluorodiphenyl.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.—Annual General Meeting.

FRIDAY, MAY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. W. de Sitter: Jupiter's Satellites (George Darwin Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Human Monsters and Malformations (3): Tumour-like Formations which appear to represent the Inclusion of one Twin within the Body of Another.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—M. G. Holmes and L. F. Salter: The Development of the London Automatic Telephone System.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. G. W. C. Kaye: The Measurement of Noise.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Forrester's Hall, Dundee).—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

PUBLIC LECTURES.

FRIDAY, MAY 1.

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. B. Ashmole: History of Ancient Sculpture.

MONDAY, MAY 4.

UNIVERSITY COLLEGE, LONDON, at 2.—Prof. E. O. Sisson: Some Movements in Higher Education in the United States.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir George Newman: The Rise of Preventive Medicine (Heath Clark Lectures) (1).

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY—ROYAL COLLEGE OF SCIENCE, at 5.30.—Sir Arthur Smith Woodward: Modern Progress in Vertebrate Palæontology (Huxley Memorial Lecture).

KING'S COLLEGE, LONDON, at 5.30.—Dr. V. Cofman: Biophysical Chemistry of Colloids and Protoplasm. (Succeeding Lectures on May 11 and 18.)

WESTMINSTER HOSPITAL MEDICAL SCHOOL, at 5.30.—Dr. M. Cheval: The Treatment of Malignant Tumours by Radium placed at a Distance. (Succeeding Lecture on May 5.)

TUESDAY, MAY 5.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 2.—Dr. C. F. White: Port Work.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. L. Hogben: Some Aspects of Human Inheritance (2): The Race Concept.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir George Newman: The Rise of Preventive Medicine (Heath Clark Lectures) (2).

INSTITUTE OF PATHOLOGY AND THERAPEUTIC RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON, at 5.—Sir Almroth E. Wright: The Organisation and Methods of Medical Research.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy in Twelve Chapters: a Summary of Recent Advances. (Succeeding Lectures on May 6, 7, and 8.)

WEDNESDAY, MAY 6.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. E. A. Westermarck: Pagan Survivals in Muhammadan Culture. (Succeeding Lectures on May 7 and 8.)

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir George Newman: The Rise of Preventive Medicine (Heath Clark Lectures) (3).

KING'S COLLEGE, LONDON, at 5.30.—Lt.-Genl. Sir George F. McMunn: The North-West Frontier of India.

THURSDAY, MAY 7.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir George Newman: The Rise of Preventive Medicine (Heath Clark Lectures) (4).

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL, at 5.—Prof. S. J. Cowell: Medical Aspects of Nutrition. (Succeeding Lectures on May 14, 21, 28, June 4 and 11.)

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. R. J. Lythgoe: Special Sense Physiology. (Succeeding Lectures on May 14, 21, 28, June 4 and 11.)

INSTITUTION OF CIVIL ENGINEERS, at 5.30—Prof. M. Jakob: Steam Research in Europe and in America. (Succeeding Lectures on May 8, 14, and 15.)

KING'S COLLEGE, LONDON, at 5.30.—Prof. W. J. Dilling: The Pharmacology and Therapeutics of Lead Colloids. (Succeeding Lectures on May 8 and 11.)

FRIDAY, MAY 8.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 2.—Dr. J. J. Buchan: Industrial Hygiene: The Rôle of the M.O.H.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir George Newman: The Rise of Preventive Medicine (Heath Clark Lectures) (5).

CONFERENCE.

THURSDAY, MAY 7.

ROTHAMSTED EXPERIMENTAL STATION, at 11.30 A.M.—Conference on The Technique of Field Experiments. In Chair: Sir A. D. Hall.

Dr. R. A. Fisher: Principles of Plot Experimentation in Relation to the Statistical Interpretation of the Results.
Prof. R. G. Stapledon: The Technique of Grassland Experiments.
W. H. Parker: The Technique of Variety Trials.
A. H. Lewis: Multiple Schemes of Field Experiments. (A. H. Lewis, A. D. Manson, J. Procter.)
T. N. Hoblyn: The Technique of Horticultural Experiments.
H. V. Garner: Practical Details of Experimentation on Ordinary Commercial Farms.
D. J. Watson: Methods of Estimation of Crop Growth and Yield.

ANNUAL MEETING.

MAY 7 AND 8.

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers), at 10 A.M.

Thursday, May 7, at 10 A.M.—General Meeting.
Induction of new President, Col. Sir Charles Wright, Bart.
Presentation of Bessemer Gold Medal to Sir Harold Carpenter.
Presidential Address.
O. Cromberg: Production Economy in Iron and Steel Works.
A. Robinson: The Melting Shop of the Appleby Iron Company, Limited.
At 2.30.—First Report on the Corrosion of Iron and Steel. Being a Report by a Joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers to the Iron and Steel Industrial Research Council.
L. B. Pfeil: The Constitution of Scale.

Friday, May 8, at 10 A.M.—General Meeting.
Announcement of the award of the Andrew Carnegie Research Scholarships for 1931-32.
Announcement of the award of the Carnegie Gold Medal to Dr. E. Valenta.
Announcement of the award of the Williams Prize to F. Bainbridge.
Dr. W. Rosenhain and A. J. Murphy: Accelerated Cracking of Mild Steel (Boiler Plate) under Repeated Bending.
H. J. Gough and A. J. Murphy: On the Nature of Defective Laminations in Wrought-Iron Bars and Chain Links.
A. L. Norbury and E. Morgan: The Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron.
At 2.30.—V. Harbord: The Basic Process. Some Considerations of its Possibilities in England.
E. C. Evans, L. Reeve, and M. A. Vernon: Blast-Furnace Data and their Correlation.—Part II.
C. O. Bannister and W. D. Jones: The Sub-Crystalline Structure of Ferrite.
C. H. M. Jenkins and H. J. Tapsell: Some Alloys for Use at High Temperatures. Complex Iron-Nickel-Chromium Alloys. Part III.—The Effect of Composition and Exposure to High Temperatures.

Papers to be presented and discussed by correspondence:—
Sir H. C. H. Carpenter and J. M. Robertson: The Formation of Ferrite from Austenite.
J. H. Chesters and W. J. Rees: Refractory Materials for the Induction Furnace.
Dr. J. Newton Friend and W. West: The Resistance of Copper-Nickel Steels to Sea Action.
E. Öhman: X-Ray Investigations on the Crystal Structure of Hardened Steel.
G. Phragmén: X-Ray Investigation of Certain Nickel Steels of Low Thermal Expansion.