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Population Problems

IN its widest meaning, population is one of those complex encyclopædic subjects which touch at some point or other, directly or indirectly, practically every branch of human knowledge. This is more emphatically the case to-day, for problems of population are no longer limited to merely quantitative considerations, but involve so many issues of a qualitative kind, and concern themselves so much with the 'quantum of happiness', differential survival, eugenics, standards of living, optimum density, and above all with the many complexities of labour and employment, that an adequate treatment of the subject demands the loyal and concentrated efforts of workers in many fields of study. We have travelled far from the Malthusian balancing of two mighty and opposite forces—man's power of increase on one hand and the limiting effects of war, starvation, etc., on the other—and we have opened up correspondingly wider vistas of supreme interest. Yet Malthus is by no means entirely thrown overboard.

In his introduction to the report of the proceedings of the Second General Assembly of the International Union for the Scientific Investigation of Population Problems,* Sir Charles Close, president of the International Population Union, says that it (the Union) invites, for the efficient prosecution of its task, the co-operation of biologists, sociologists, anthropologists, statisticians, economists, students of agricultural economics, and, it may be added, geographers and historians. Even this formidable list is scarcely sufficient, and must be extended to include medical men and physiologists.

In his admirable report on the work of Commission 1, dealing with population and food supply—one of the most able contributions in the whole proceedings—Dr. J. D. Black of Harvard observes that population science is co-ordinating in character. It takes the results of researches in basic natural and social sciences and focuses them on the problems of population change, deriving therefrom a set of generalisations relating especially to population.

One of the most vital and important of the practical results which might be expected to follow from a thorough study of world population problems is some light on the many difficulties

* Problems of Population: being the Report of the Proceedings of the Second General Assembly of the International Union for the Scientific Investigation of Population Problems, held at the Royal Society of Arts, London, June 15–18, 1931. Edited by G. H. L. F. Pitt-Rivers. Pp. 378. (London: George Allen and Unwin, Ltd., 1932.) 15*s*. net.

which envelop the movements of large bodies of people from one part of the world to another, that is, migration. But the present proceedings have little to say on this subject, beyond the one paper contributed by the late Prof. J. W. Gregory, on "Some Effects of Current Migration Restrictions". This, so far as it goes, is certainly of profound interest, but neither here nor in any of the other papers are there any really serious constructive proposals, except a reference to the suggested international agreement on the regulation of migration made at the previous Conference in 1927, to the probability of war if no agreement were reached, and to the urgent need for some international organisation to seek a solution of migration problems.

In no region of economic or social policy have there been higher and brighter hopes, or darker and more bitter disappointments, than in the matter of emigration, at least so far as Great Britain and one or two others of the crowded parts of Europe are concerned. But if the main issue is to be clouded, or if hope for world recovery, so far as it is based on emigration, is to be thus summarily dashed at the outset by strange paradoxes or nebulous hypotheses of this sort, what can be expected of the bewildered statesmen of the world seeking guidance, or the still more bewildered populace thirsting for political wisdom and light in dark places?

The emigration policies hitherto pursued could not possibly meet with any other than the richly deserved fate of dismal failure. To send emigrants, mostly town-bred, in small isolated parties to the wilds of Canada or elsewhere, to grow wheat or other agricultural produce for world markets already surfeited, is the height of folly. Emigration of such a one-sided nature, based on agriculture alone, is obviously inadequate. With wider vision, it would long ago have been realised that emigration should be based mainly on the principle of self-support: large self-supporting communities, townships, villages, should be established where not only agriculture but also all necessary manufactures could be carried on, including opportunities for part-time farm or garden work, as well as cottage industries and handicrafts. The emigrants would take their own market with them and their labour would be mainly applied to supplying their own needs. This is not the place to elaborate on the possibilities in this direction. It will suffice to point out that such a policy could be applied largely to settlements in Great Britain as well as to overseas, and many of our unemployed could be thus happily organised, and restored once more to hope and opportunity for useful work and independence.

In regard to the reports of research commissions and national committees appended at the end of the volume before us, by far the most valuable and comprehensive of these is that of Dr. J. D. Black on population and food supply, providing among other things an intensive survey of agricultural economics, and emphasising the importance of the balance between manufacturing industry on one hand and agriculture on the other, a balance which may be and very often is seriously disturbed by various political expedients such as tariffs.

The many variations in the pressure of population on food supply, and the causes of these variations, are fully dealt with, also the several ways in which food supply may be increased and, what is probably of still greater importance, used to best advantage as indicated by the newer knowledge of nutrition. Dr. Black outlines a very comprehensive programme of research in these and related matters, and by way of indicating how large and important is the field of research, he says we are very far from knowing (1) how much the yield of a given crop per acre can be increased: one writer has claimed that yields of wheat can be increased to 172 bushels per acre; (2) how far yields can be increased economically under the conditions existing in different countries; and (3) how much plant and animal breeding may yet add to the yields of crops and livestock. Some of the chief problems, as producers have found to their cost in recent years, are not concerned with production, but with consumption, markets, prices, and distribution generally.

When one looks at world population as a whole, it is very difficult, even with the most careful and complete analysis, to deduce many sound generalisations or conclusions valid for the whole world. Even if it could be established by complete statistics, the average increase or decrease in world population would be a figure of little value, so great are the variations in conditions at different periods and in different areas. As regards quality, quantum of happiness, optimum density and so forth, these require the whole gamut of social and political sciences, to say nothing of ethics and moral philosophy, for their adequate discussion.

The present volume of proceedings, varied and

comprehensive as is its scope, still leaves untouched some very weighty matters concerning the relations of eastern and western peoples, of white and black in various parts of the world, of the dying out of some races and causes thereof, of the strange problems presented by the Semitic dispersal and possible re-union, and much else. Vast areas of the earth's surface are scarcely mentioned, such as India, China, Africa. How long, if ever, will it be before we reach that amazing consummation described by the poet Campbell in "The Last Man", when all population problems will have been solved, so far as this planet is concerned; and are other parts of the universe peopled?

Yet prophet-like that lone one stood,
With dauntless words and high,
. . . . .
Saying, we are twins in death, proud Sun,
Thy face is cold, thy race is run,
'Tis mercy bids thee go;
For thou ten thousand thousand years
Hast seen the tide of human tears,
That shall no longer flow.
. . . . .
Go, tell the night that hides thy face,
Thou sawest the last of Adam's race,
On earth's sepulchral clod,
The darkening universe defy
To quench his immortality,
Or shake his trust in God.

W. G. L. C.

Quartz-bearing Igneous Rocks

A Descriptive Petrography of the Igneous Rocks. By Prof. Albert Johannsen. Vol. 2: *The Quartz-Bearing Rocks.* Pp. xxxi+428. (Chicago: University of Chicago Press; Cambridge: At the University Press, 1932.) 33*s.* net.

THE second volume of Prof. Johannsen's work on petrography is both a descriptive petrography of the quartz-bearing igneous rocks and an illustration of the author's proposed new method of classification. In it the rocks are described as a number of families that have strict quantitative limits, the factors concerned being the ratio of the light-coloured and dark-coloured minerals present, the ratio of quartz to total felspar, the quantitative relations of the potash felspar to the plagioclase felspar, and the actual character of the plagioclase present. It is to be noted that the minerals concerned are those actually occurring in the rock, so that the classification is modal. The author freely admits the difficulty that arises in the case of the glassy rocks and suggests that the 'norms' may be of service here.

As the system is outlined, it provides for about three hundred families, but there are no known representatives of many of these. The limits of the families are such that many of the older names have had to be re-defined, and the type restricted. For the related families a new nomenclature has been devised by combining rock and/or mineral names, or by the use of prefixes of definite connotation. Thus the name granite appears in such combinations as quartz-leuco-kali-granite, kali (or calci)-granite, leuco (or mela)-granite, sodaclase (or calciclase)-granite, etc.; some other combinations are granogabbro, rhyodacite and monzodiorite. If ever a new classification is generally accepted, it is possible that such portmanteau names will express relationships and affinities better than the type of name now in use, but at first sight they appear cumbersome and confusing. The system certainly provides an adequate number of pigeon-holes into which rock specimens can be placed on the basis of certain mineral likenesses; whether the groups so formed are families in the common sense of the term is perhaps doubtful.

In a comprehensive work such as this, certain divisional points have to be taken so that the volumes may be of reasonable size. Here the author has taken the presence of free quartz. Consequently the rocks described in this volume range from igneous quartz veins to such basic types as the quartz-bearing gabbros, norites, dolerites and basalts, but the quartz-free types of those rocks are reserved for a later volume.

The several families are described under the following heads: history and definition, macroscopic and microscopic characteristics, constituents and chemical composition. Full lists of essential and accessory minerals are given, with, in the case of the more important groups, the mineralogy of the chief components. The mode of occurrence, the genesis and the weathering are adequately treated. More than two hundred tables are given. These comprise both bulk and mineral analyses, and in the case of the glassy rocks not susceptible to modal analysis the 'norms'. All modal analyses known to the writer are tabulated, and his knowledge of the literature is such that there can be few omissions. In many cases, he has made modal analyses to fill in the lacunæ; in other cases he has re-calculated the chemical analyses in terms of the minerals said to be present.

The possible variation in the families is given, assuming maximum and minimum values for the critical constituents, and these are contrasted with the observed variation. One of the difficulties the author has had to contend with here is the lack, not only of quantitative mineral analyses, but also of the chemical mineralogical data. His plea for more analyses of the chief minerals present in the rock as well as the bulk analysis is commended to all petrographers. Among the illustrations are beautifully reproduced photomicrographs, photographs of polished specimens and of field occurrences.

The general make-up of the volume is excellent, paper, type and binding being worthy of a scientific work. It is enriched with quotations from original sources in so many languages that the author must be very optimistic of the linguistic capabilities of the average geologist. The references are exceedingly numerous, and their reliability is indicated. The wealth of data provided, the excellent descriptive accounts of typical rocks, together with the historical background give the book a value quite independent of the method of classification adopted. The index is restricted to rock names, but most of those included are not in common use.

When this great work is completed—on the last page of this volume appears the quotation from *Faust*, "Jetzt lass mich los! ich komme bald zuruck"—there will be available a source book in petrography of remarkable completeness.

Educational Structure and Purpose

The Nation at School: a Sketch with Comments. By F. S. Marvin. Pp. viii+173. (London: Oxford University Press, 1933.) 5*s*. net.

MR. MARVIN opens his preface by noting that few attempts are made "to describe simply and estimate fairly" what is being done in England under the name of education. It is indeed true that the difficulty—particularly since the developments of the post-War period—is to make the layman understand our educational structure. Perhaps that difficulty was responsible for a recent publication of the Board of Education* which might well be read alongside Mr. Marvin's book.

The sub-title of Mr. Marvin's work is, "a Sketch with Comments". Let it be said at once that the sketch he gives of our educational institutions, of our general educational aims and of our difficulties, is an excellent one and deserves to be widely read. It is when his comments are noted, however, that the general approbation may be lessened. But that is not a fault. Even if his readers find that those comments stir them to the most violent disagreements, he will have accomplished the most important task of making them think of *education* rather than (as is usually the case) of the subtleties, purposes, failings and possibilities of educational administration. He frankly admits that his personal convictions appear here and there. They do, indeed; they leap out to the argumentative mind. His insistence on the individual, and on the part to be played by the parent; his apparent distrust of the State as educational organiser and dictator; these make one long to disfigure the page with the largest of marks of interrogation.

The difficulty is, however, that Mr. Marvin is so irritatingly fair. His convictions appear to be leading him to dogmatic statements, and then, just before the query mark is savagely scrawled, he arrests one's pencil in mid-air by noting a point of view quite opposite. One example will suffice. ". . . the majority of our contemporaries," he says, "are content to live in the hideous purlieus of modern towns and feast their eyes on the shrieking monstrosities of modern newspapers and cinemas. That this should go on and grow in force while eye and ear are open to all the beauty and delight of Nature in sky and sea, with the songs of birds and the shapes and colours of trees and flowers waiting to be enjoyed, is the strongest indictment of modern education". But *are* people content? Is Nature so compensatory for some of the ills of the modern State? Are there not comprehensible, if blind, reachings out towards beauty behind even the monstrosities of modern newspapers and cinemas? An inexcusable "Pah!" almost trembles on the lips and one is just about to develop a lengthier thesis of defence when Mr. Marvin disarmingly indicates the signs of a move away from the deepest trough of the factory system and the joyful omens of allotment gardens round every town.

Whatever reaction one may have to some of the comments, one will not fail to admit that no narrow educational traditions mar Mr. Marvin's fundamental view of knowledge. He emphasises that the field of knowledge is one in its human aspect and that it has two broad divisions: what man has done and thought, and his knowledge of

*Board of Education Pamphlet No. 94: An Outline of the Structure of the Educational System in England and Wales. (H. M. Stationery Office, 1933.) 9*d*. net.

Nature. The double point of view is absolutely necessary. How refreshing, too, to read in a more detailed account of the structure of knowledge, that physics may be used as a *point de repère*, and that "those who wish to see how a great unifying idea, skilfully applied, may give force and coherence to a mass of facts" should turn to the last popular presentation of biology.

An appendix, "An Outline of the Development of Technical Education in England", is contributed by Mr. A. N. Marvin.

International Telephony

Comité Consultatif International des Communications téléphoniques à Grande Distance. Plenary Session, Paris, 14th–21st September 1931. English edition. Pp. viii+362. (London : The International Standard Electric Corporation, 1932.) 21*s.* net.

THE excellent work done by the Comité Consultatif International for long-distance telephony (C.C.I.) is much appreciated by everyone interested in telephony. Considering that thirty-four telephone administrations from all parts of the world are represented on this committee, it is very satisfactory that almost unanimous agreement has been attained. It is a great achievement to have established an international telephone service. In Great Britain, any of the telephone subscribers can speak to nearly 95 per cent of the world's thirty-five million telephone subscribers. Perhaps one of the reasons of its success is that it is primarily a consultative rather than an executive body. The experience and technique of each administration is thus made available to the others.

This volume is the English translation of the proceedings of the meeting held in Paris in September 1931. It gives a clear picture of the many mathematical, physical and administrative problems which have to be considered in everyday work. Particular stress is laid on definitions, but we were sorry to notice that both 'nepers' and 'decibels' are still used for units of transmission. The former is perhaps the more scientific as napierian logarithms are used, but the latter, which uses decimal logarithms, is the more melodious and is used by physicists. Excellent definitions are given of cross-talk, side-tone, room noise, babble, etc. Cross-talk is defined as intelligible voice currents arising from voice currents in a neighbouring telephone channel, and babble is the combined effect of several cross-talks.

In an appendix, an interesting communication on "Noise" by Prof. Karl Willy Wagner, of the Heinrich Hertz Institute for the investigation of wave motion, is given. Prof. Wagner points out that people living in cities are getting more and more crowded together, and so the influence of noise is getting more and more important. Schopenhauer said that noise is the murderer of thought and complained of the noise made by coachmen's whips. Herbert Spencer said that one criterion of man's intellect is the horror he has of all useless noises. It is stated that experiments made in the United States have shown that noise is detrimental both to health and working capacity. A wall in a residential dwelling can transmit sound in two ways. The sound may either penetrate as a longitudinal vibration or the wall may be set into vibration by the acoustic pressure in one room and transmit to an adjacent room as if it were a large diaphragm. Recent tests at the Hertz Institute show that the diaphragm effect of the wall practically determines its permeability to sound.

The Earth's Figure

Physikalische Geodäsie. Von F. Hopfner. (Mathematik und ihre Anwendungen in Monographien und Lehrbüchern, begründet von E. Hilb, herausgegeben von Prof. E. Artin und Prof. G. Kowalewski, Band 14.) Pp. xi+434. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1933.) 31 gold marks.

THIS book, on physical geodesy, discusses the earth's figure from the point of view of the mathematical theory of attractions ; the technical details of the *measurement* of the actual form and attraction of the earth find no place in it. The work is not intended for beginners, as the author states in his preface ; but a certain amount of introductory pure mathematics is given in the first three chapters, on the transformation of Laplace's equation to elliptic co-ordinates, and on spherical harmonic and Lamé's functions. Then follow chapters on the general theory of attractions and potential, the gravitational field of the homogeneous ellipsoid, the problem of relative equilibrium for a rotating fluid mass, and the ellipsoids of Maclaurin and Jacobi, together with Poincaré's discussion of neighbouring figures of equilibrium ; questions of stability receive only a bare mention.

The last part of the book is devoted to the

problems of Clairaut and Bruns. The first of these concerns the flattening of the level surfaces, and the surface distribution of gravity, for a slowly rotating fluid body stratified, parallel to the surface, in layers each of uniform density; the treatment in this book is simplified by assuming isostasy for the layers, so that the surfaces of equal pressure and density coincide; the problem is to find the form of the surface, in equilibrium, for any assumed law of variation of density along a radius.

After a chapter on the development of the potential in a series of spherical functions, the remainder (more than a quarter) of the book deals with Bruns's problem. Bruns's theory considers a (supposed given) distribution of rotating matter, and discusses the corresponding surfaces of constant potential W (due to gravitation and centrifugal force); the fundamental problem of geodesy is regarded as consisting, not in the determination of some one special level surface, called the earth's figure, but in the determination of all the level surfaces, which is equivalent to determining the potential W. The author gives a clear account of the work hitherto done upon this subject by Bruns, Poincaré, Rudzki, Stokes and others, written from a unitary point of view, that of boundary problems in potential theory. The bearing of the work upon the actual earth is explained with perhaps undue brevity, the outlook throughout being very mathematical. The book should, however, be of great service to geodesists who aim at really fundamental work on the earth's figure.

Short Reviews

Air Ministry: Meteorological Office. *British Rainfall 1932: the Seventy-second Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1932 as recorded by over 5,000 Observers in Great Britain and Ireland.* (M.O. 355.) Issued by the Authority of the Meteorological Committee. Pp. xviii+291. (London: H. M. Stationery Office, 1933.) 15*s*. net.

For the British Isles as a whole, the rainfall of 1932 was 102 per cent of the average, the year forming the tenth successive one with a fall in excess. There were frequent dry spells during the year, but a very wet May brought widespread floods, especially in the Don valley in Yorkshire. In the matter of heavy storms and 'cloud-bursts', the year was somewhat milder than its two predecessors, but as usual provided a share. Thus on July 11, 4·96 inches fell in two hours at Cranwell Aerodrome in Lincolnshire. Incidentally, the annual volumes of "British Rainfall" bear eloquent testimony to the fact that rain in England is far from always of that gentle character so often referred to by those familiar with the torrential downpours of tropical countries.

In special articles Messrs. E. G. Bilham and A. C. Lloyd discuss the "Frequency Distribution of Daily Rainfall" and Dr. J. Glasspoole produces a detailed map of the average distribution of rainfall in the Tees Valley. In a third article, Mr. F. Hudleston continues his investigations at Penrith relating to rain-gauge shields in exposed positions. He shows clearly that we have not yet found out how to get a precise record of the rain that falls on an exposed hillside. In connexion with these experiments, conducted between May 1, 1932, and April 30, 1933, the tremendous snowstorm of February 24–26, 1933, which brought 2½ ft. of snow and filled gullies with drifts to a depth of 40 feet, led to some useful conclusions. L. C. W. B.

Handbuch der Chemotherapie. Von Dr. Viktor Fischl und Prof. Dr. Hans Schlossberger. Teil 1: *Metallfreie organische Verbindungen.* Pp. viii+357. (Leipzig: Fischers medizinische Buchhandlung, 1932.) 34 gold marks.

This book is an extremely useful compendium of information, admirably classified and sub-divided. Under the various subsections are given not only the chemical composition and pharmacological properties of an extremely large number of substances of therapeutic importance, but also excellent surveys of the literature. The substances described include both synthetic and natural medicaments, but no attempt is made to give actual or possible methods of preparing substances in either category. This is a wise restriction of scope, since that information is easily accessible in other works.

Unlike some other German organisations, the publishers of this book give a definite indication of the number of volumes in which it is to be completed, and the approximate price of the remaining two parts. Part 2 is to cover metallic derivatives, and part 3 will be a general section in which theories of chemotherapy will be set forth, and will include a discussion of the trustworthiness of various products and of standardisation of methods. It is to be hoped that it will also include a thoroughly adequate index, since this is absent from part 1. A. L. B.

An Introduction to the Sociology of Islam. By Reuben Levy. (Published for Herbert Spencer's Trustees.) In 2 vols. Vol. 2. Pp. v+426. (London: Williams and Norgate, Ltd., 1933.) 21*s*. net.

In the second volume of this sociological study of Islam, the author covers the religion and ethical conceptions, customs and secular law, government, military organisation and science. Under religious

conceptions he summarises not only the main doctrines of the Koran, but also those of the chief sects and heretical schools of Islamic thought. Necessarily the treatment is brief, and must be regarded as introductory rather than as exhaustive. In his survey of secular law and custom, he indicates the manner in which Islam has modified and adapted itself to local custom and tribal law—one of the principal, if not the chief, of the sources of the strength of its hold over a diversity of peoples. This adaptability is especially to be noted in the manner in which religious difficulties have been overcome in the introduction of a Western system of popular government in Turkey.

The field covered by the author in his two volumes is extremely wide; but notwithstanding the limitations of space, he has succeeded in giving a lucid account of the essential features in a system of the first importance in the past history and in contemporary politics of the East.

Le mystère et de paradoxe du vol animal. Par Dr. Émile Batault. Pp. xiv+236. (Paris: Gauthier-Villars et Cie, 1933.) 50 francs.

PURELY mechanical theories of flight in animals on one hand attribute to the organism an exaggerated muscular power incompatible with the findings of physiology, and on the other hand under-estimate (in the formula ksv^2) the resistance due to the air upon which the wings are obtaining purchase. These inaccuracies are eliminated if the stroke of the wing be looked upon, not as a single movement, but as a succession of short impulses in very rapid succession, so that the muscles actuating the wing are working at their physiological optimum.

In insects, more than in birds, the suddenness and rapidity of the wing-beat, running to hundreds a second, is apparent, and this motion, which has its equivalent in the wing-beat of a bird, helps to explain the relatively feeble expenditure of physiological energy in regard to the weight sustained demanded by flight. Because of this peculiar action of the living organism, analogies between animal flight and the mechanical flight of flying machines are misleading. J. R.

The Old Stone Age: a Study of Palæolithic Times. By M. C. Burkitt. Pp. xiv+254+9 plates. (Cambridge: At the University Press, 1933.) 8*s*. 6*d*. net.

MR. BURKITT'S "Old Stone Age", a textbook for students, may for the purposes of a wider public be regarded as a progress report. Although it is a study of the period as a whole, and as such is complete within the limitations imposed upon detail by space, its special interest lies in the author's pronouncements upon recent developments in the study of the earliest periods of prehistory. One such, for example, is the discussion on typology and the implications which arise therefrom, more particularly the differentiation of the *coup-de-poing* makers of western Europe and the flake-tool makers of farther east, and the possibility of a racial distinction to which it seems to point. Mr. Burkitt is at one with Dr. Menghin in his view that a reclassification of stone age industries is necessary—although he does not express admiration for that author's terminology—and would restrict the nomenclature and classification of palæolithic industries now in use to western Europe.

Sex Determination. By Prof. F. A. E. Crew. (Methuen's Monographs on Biological Subjects.) Pp. ix+138. (London: Methuen and Co., Ltd., 1933.) 3*s*. 6*d*. net.

IN this little monograph, Prof. Crew adds both to his own reputation as an exponent of his subject, and to the reputation of the admirable series of which it forms a part. Though his treatment is as clear as is humanly possible, he has been handicapped, like other writers in the series, by the extreme condensation that the size of the monograph demands. To have covered the whole subject of sex determination in 111 small pages of text (to which must be added 11 pages of bibliography, 5 pages of glossary, and author and subject indexes) would not have been possible with accuracy, had it been necessary to indulge in simplifying periphrases. As it stands, the book should prove an invaluable source of information and references both to those actually working in the field, and to those having to make occasional incursions into it. A. L. B.

The Mode of Action of Drugs on Cells. By Prof. A. J. Clark. Pp. vii+298. (London: Edward Arnold and Co., 1933.) 18*s*. net.

IN this book, Prof. Clark has expanded three lectures delivered in London in 1932. It probably forms the most complete presentation hitherto available of a quite recently developed aspect of pharmacology. When it is realised that statistical methods and thermodynamical considerations are both involved in Prof. Clark's exposition, and that a knowledge of physiology, pharmacology and biochemistry is taken as a matter of course, it will be obvious that the volume is essentially one for the specialist. Its importance lies in the very fundamental problems raised by the author, and in his own position as one of the most original and penetrating thinkers and experimenters working to-day in his particular field. A. L. B.

Handbook of Mathematical Tables and Formulas. Compiled by Dr. R. S. Burington. Pp. vii+251. (Sandusky, Ohio: Handbook Publishers, Inc., 1933.) 2 dollars.

PART 1 contains a convenient summary of formulæ and theorems from elementary mathematics, including tables of the more useful integrals. Part 2 contains thirty tables, including separate tables of common logarithms to four, five and seven places. The matter is well selected, conveniently arranged, typographically excellent, and the handbook, pleasant to handle, is altogether a very satisfactory work.

New Results in Cosmic Ray Measurements*

By PROF. E. REGENER, Technical High School, Stuttgart

IN recent years I have endeavoured to explore the decay of the intensity of cosmic radiation over as wide a range as possible after its entrance into the earth's atmosphere. I believe that such an investigation is indispensable before a theory of the nature of cosmic radiation can be put forward. In NATURE[1] and in the *Physikalische Zeitschrift*[2] I have already given some preliminary account of our measurements of the intensity of the cosmic radiation in the upper atmosphere. I propose to give here some further results, obtained in recent ascents with registering balloons, but first a few improvements of the apparatus which we have introduced must be described.

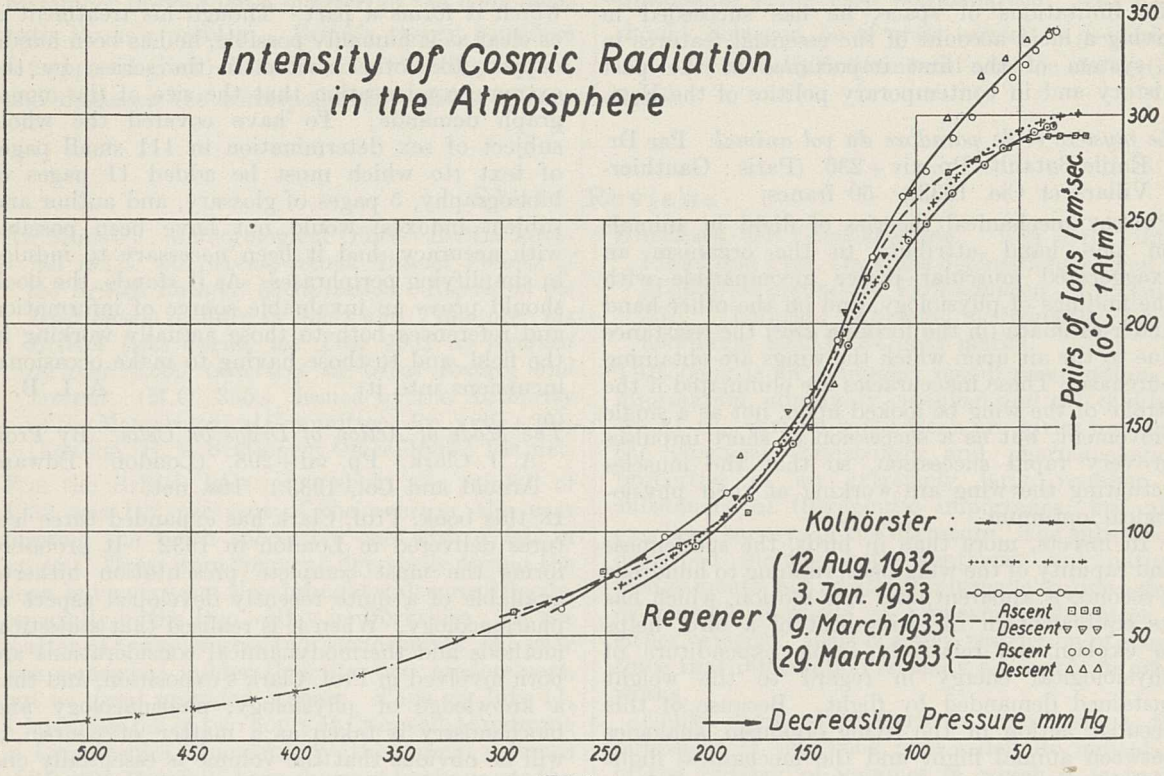

FIG. 1.

The balloon electrometer includes an electrometer system (a thin Wollaston wire, a quartz sling giving the directing power), the photographic objective, projecting the electrometer wire on the photographic plate. The wire is illuminated every four minutes from the side, so that it appears bright on a dark background on the photographic plate. There is also an aneroid barometer for the measurement of the air pressure and a bimetallic lamella for measuring the temperature. The movement of the aneroid, when the pressure decreases, limits by a pointer the image of the electrometer wire on the photographic plate. Since the measurement of the pressure is the most delicate part, especially when the pressure is low, we have added to the ordinary aneroid a second one, which only starts indicating when the pressure falls below one hundred millimetres. By observing the balloons in the air with two theodolites from a base of three to four kilometres, we have been able to prove that the measurements of the pressure with these two aneroids are fairly exact. The agreement with the height deduced from the pressure measurements was very good.

We have also employed another form of balloon electrometer. Our balloon electrometers hitherto constructed each had the ionisation chamber filled with air at a pressure of three or four to five atmospheres. The new electrometer has an *open* ionisation chamber, that is to say, a chamber communicating with the air outside through a tube containing phosphorus pentoxide. The pressure in this chamber decreases as the balloon rises in the free atmosphere, and the ionisation chamber in this case must be larger in order to obtain adequate sensitivity. But such an arrangement is very convenient for measuring the absolute value of the ionisation due to the radiation, because it is much easier to obtain the saturation current at

* Paper before Section A (Mathematical and Physical Sciences) of the British Association, delivered at Leicester on September 8.

a low pressure. In the ordinary ionisation chamber, which is filled with gas at high pressure, it is well known that it is very difficult to obtain the saturation current.

Fig. 1 shows the results of the four best registrations of the cosmic radiation with the closed balloon electrometer. The minimum values of the air pressure on these four ascents are respectively:

August 12, 1932: 22 mm. mercury, 5·4 atmospheres pressure in the ionisation chamber.

January 3, 1933: 34 mm. mercury, 4·45 atmospheres.

March 9, 1933: 17·6 mm. mercury (this is the lowest pressure hitherto reached), 3·28 atmospheres.

March 29, 1933: 32 mm. mercury, 5·33 atmospheres.

It is noteworthy that the first three ascents agree very well among themselves. Also the fourth ascent agrees with the others very well at the medium heights at a pressure of 150 mm. mercury (that is, at a height of about twelve kilometres). But in the upper atmosphere, that is, at pressures of less than 100 mm., at heights greater than fifteen kilometres, and even more so at heights of twenty kilometres, the intensity begins to be much greater than on the other ascents, so that the maximum value is nearly fifteen per cent greater than on the other ascents. This is probably *not* due to the inaccuracy of the measurements. It can be seen that the middle parts of the fourth curve agree very well with the others. Moreover the fourth registration, of March 29, 1933, is the best of all with the closed electrometers. It was also possible to obtain observations during the descent of the balloon (Fig. 1). These observations showed that the ordinary and the secondary aneroids worked very well.

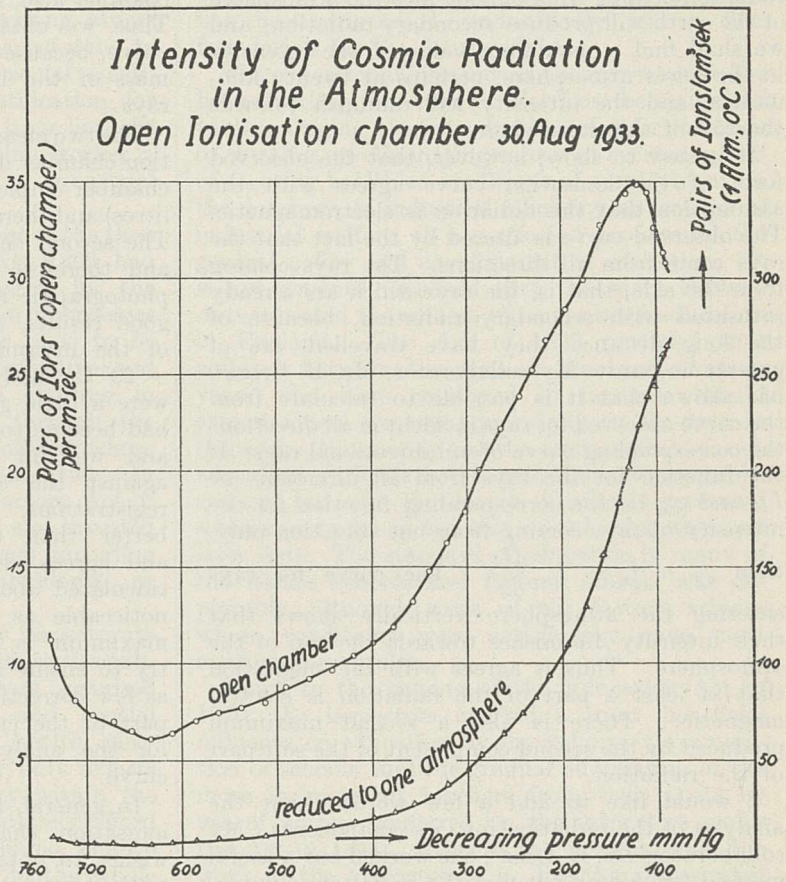

FIG. 2.

The temperature during the hour in which the balloon was in the stratosphere varies comparatively little, from 6·5° to 11°C. That is due to the 'Cellophane' case, surrounding the electrometer like the glass of a forcing house and protecting it against the cold in the stratosphere.

We believe that the difference of the fourth curve from the others is real, and we have tried to find an explanation. We searched for the cause in the circumstances accompanying the four ascents. On the fourth ascent there was a new moon and we thought that perhaps radioactivity of the moon was the cause of the greater intensity on this day; for on the other ascents the moon was not in the sky. Incidentally, it should be noted that at a pressure of twenty or thirty millimetres of mercury, already one-third of the γ-radiation of ordinary radioactive bodies could penetrate into the atmosphere. But a little calculation shows that the radioactivity of the moon would have to be improbably great to do this, so this explanation cannot be true. Then we inquired into the magnetic disturbances on the four days. Both Prof. A. Nippoldt at Potsdam and Dr. A. Corlin in northern Sweden informed me that on March 29 there was a magnetic disturbance of medium strength, but the other days were magnetically calm. It would be remarkable if there were a connexion between the magnetic intensity and the intensity of the cosmic rays in the highest parts of the atmosphere, and only in the highest parts; that is to say, that there are additional rays (soft rays) there, perhaps coming from a sunspot. But up to now we have observed this but once. Further observations are necessary in order to ascertain whether this is real.

From the measurements of the decay of the intensity of the cosmic radiation in Lake Constance,

my collaborator, Dr. W. Kramer[3], has deduced that there are many components of the radiation.

From Sir James Jeans's hypothesis, one can calculate that the hardest two components correspond to the annihilation of a helium atom and of a proton. But there are many assumptions in this calculation. It is often objected that the fact ascertained in our ionisation curve in the atmosphere, that the ionisation curve approaches a maximum value at the top of the atmosphere, is *not* in favour of the hypothesis, that the primary radiation is electromagnetic. Electromagnetic radiation coming from outside into the atmosphere of the earth will produce secondary radiation, and we shall find a maximum value of the intensity in the lower atmosphere, perhaps at twenty kilometres, and the intensity will diminish towards the top of the atmosphere.

It is easy to show, however, that the observed form of the ionisation curve agrees with the assumption that the radiation is electromagnetic. The observed curve is altered by the fact that the rays come from all directions. The rays coming from the side, that is, the rays which are already saturated with secondary radiation, because of the long distance they have travelled, are of greater account. My collaborator, Mr. B. Gross[4], has shown that it is possible to calculate from the curve observed for rays incident in all directions the corresponding curve of uni-directional rays. If the function for the rays from all directions be I_x, and ψ_x be the corresponding function for the intensity of rays coming from one direction only, then $\psi_x = I_x - I_x \frac{dI_x}{dx}$. The curve for rays entering the atmosphere vertically shows that their intensity diminishes towards the top of the atmosphere. Thus it agrees with the suggestion that at least a part of the radiation is electromagnetic. There is also a second maximum produced by the second component of the soft part of the radiation.

I would like to add a few words about the analysis of the radiation into its components. My collaborator, Dr. E. Lenz[5], has worked out a useful method for finding whether the radiation is monochromatic or contains more than one component. This method is independent of any assumption regarding the nature of the rays. Suppose that the intensity is a monotonic function of the absorption of monochromatic radiation. When the intensity I is multiplied by the thickness d of the absorbing layer, this gives a curve with a maximum at a certain value of d. If the radiation consists of two components of different penetrating power, then there are two maxima in the curve (let us say in the *deformed* curve), deduced from the original curve by multiplying the intensity by the thickness of the layer. When our experimental results are plotted in this way, the curve shows that the radiation in the atmosphere consists of two or three components of different penetrating power.

It is also possible in an experimental way to decide whether the decomposition of the radiation in components is real. When the intensity of radiation in the free atmosphere is observed with an open ionisation chamber, we do the same as we have just done in a mathematical way. The ordinary curve of the intensity of the radiation is a curve obtained with an ionisation chamber containing air at a pressure of one atmosphere. When we work with an open ionisation chamber, we find a value of the current in the chamber which is smaller in the same ratio as the pressure in the air, and thus in the chamber also, is smaller than the normal pressure. Thus we obtain directly a deformed ionisation curve, because the pressure is in proportion to the mass of the layer which is penetrated by the rays.

The two measurements made with such an ionisation chamber do not quite satisfy us yet. The first chamber employed was too small (volume only 22 litres) and therefore the sensitivity was inadequate. The second chamber had a volume of 105 litres and therefore the sensitivity was sufficient. A photographic record obtained on August 30 gave good results, but unfortunately the temperature of the instrument went down very low, below $-20°$ C., and therefore the corrections needed were a little greater than usual. The apparatus had become too heavy (3·7 kgm.) for our balloons and we did not employ sufficient safeguards against the cold. But on working out the registrations, the curve (Fig. 2) is already better than those with the closed chamber, and agrees very well with the deformed curve calculated above. The second maximum is also noticeable as in the deformed curve, but this maximum is not very distinct and we shall try to ensure more favourable conditions so that as few corrections as possible are necessary. This part of the curve, I believe, is most important for the analysis and the explanation of the curve.

In general, the method of employing the open ionisation chamber is very convenient if one wishes to obtain the whole curve from sea-level to the top of the atmosphere, because the observed values with the open chamber vary only from 1 to 5, while the ionisation in the closed chamber varies from 1 to 150. Thus, in Fig. 2, the normal intensity curve is more accurate in the lower parts than with the closed chamber. The values for the normal curve are obtained from the values with the open chamber by multiplying them by p_0/p.

I offer my thanks to Mr. B. Auer for helping me in the measurements and to the Notgemeinschaft der Deutschen Wissenschaft for supporting my investigations.

[1] E. Regener, NATURE, **130**, 364; 1932.
[2] E. Regener, *Phys. Z.*, **34**, 306; 1933.
[3] W. Kramer, *Z. Phys.*, **85**, 411; 1933.
[4] B. Gross, *Z. Phys.*, **83**, 214; 1933.
[5] E. Lenz, *Z. Phys.*, **83**, 194; 1933.

Health in Industry

THE annual report of the Chief Inspector of Factories and Workshops for the year 1932* is a more than usually interesting document. Since the present year marks the hundredth anniversary of the appointment of the first Government inspectors of factories in Great Britain, much of the report has been devoted to historical reviews of the development of the functions and responsibilities imposed on this department by progressive legislation. These reviews give an impressive picture of the contribution which scientific workers among others have made through the factory inspectorate to the amelioration of industrial and social conditions, and afford a substantial justification for many of the arguments which have been brought forward for according to the scientific worker a wider share in the responsibilities of industrial and national administration.

Prior to the Act of 1833, enforcement of the then existing legal requirements, dating from 1802, had been entrusted to 'visitors' appointed by the Justices of the Peace, many of whom themselves might be the owners of factories or mills to be inspected. This system had proved ineffective, and the laws regulating the labour of children in factories had been evaded, partly through the failure to appoint proper visitors or officers whose special duty it was to enforce their execution. In pursuance of Section XVII of the Factory Act of 1833, four inspectors were appointed and invested with both judicial and executive powers, including the authority to appoint 'superintendents' or sub-inspectors as required.

The gradual growth of the factory inspectorate from such modest beginnings to its present establishment, which includes 246 inspectors organised in eleven geographical divisions, and special branches concerned with industrial health, electrical work and engineering, however, only reflects the development of modern industry within the same period. Numerical statistics scarcely afford an accurate indication of the profound change which the inspectorate has effected in the whole spirit and outlook of modern industry, but it is fair to say that the present expenditure of £174,164 annually on the department earns dividends in human welfare and industrial efficiency as invaluable to the State in general as to the workers or industries directly concerned.

The magnitude of this transformation is the most vivid impression indeed derived from the restrained but able surveys presented in this report, and the achievements of the inspectorate are rightly a source of almost as much satisfaction and pride to industry or to the community in general as to the inspectors themselves. The task confronting the original four inspectors of enforcing an unknown and unpopular Act, at a time when men were naturally eager to make the most of the opportunities offered by the untried resources of mechanical power, was most formidable; it was enhanced by prevailing ignorance of the limitations imposed by Nature on human endurance, and of the true interests of both the workers themselves and the industries they served. The wisdom of the early inspectors in relying upon educational and persuasive methods rather than upon the full exercise of their autocratic powers—a policy which has been continued—undoubtedly laid a firm foundation for the future edifice.

The educational influence of the inspectorate has been startlingly successful. Far from being limited to encouraging the introduction of safer methods of working, of eliminating causes of accidents, and of securing healthier conditions of employment, in the interests of industrial efficiency as well as of industrial welfare, it has affected profoundly the general policy and development of education. It is not generally realised that the early Factory Acts initiated the system of compulsory education in England. The Act of 1833 provided that children between the ages of nine and thirteen years who were employed in factories should attend school for two hours daily on six days in the week. Not merely was the arrangement of such attendance difficult to fit in with the customary shift system, but also the dearth of schools presented serious obstacles in the way of enforcing this and later Acts. The standard of education in many of the dames schools and factory schools was deplorable, although some of the factory schools where conditions were satisfactory gave most encouraging results.

Down to the passing of the Education Act of 1870, the inspectors exerted a most beneficial influence on education by the voluntary examination of schools, and the gradual elimination of the more incompetent teachers from their posts by use of powers conferred on the inspectors under the Act of 1844. Even at the present time, the work of the inspectorate in directions illustrated by the Home Office Industrial Museum, the lectures given on industrial safety at technical schools and elsewhere, the assistance given to work on vocational guidance and the "safety first" movement, represents a direct contribution to education which is of the utmost importance.

One of the most prominent aspects of the work of the factory inspectors has been that relating to safety, and the reports of the earlier inspectors on the alarming conditions then existing, the numerous accidents and the frequency of fatalities, assisted in large measure in securing the inclusion in the Factory Acts of 1844 of requirements regarding the fencing of machinery, the provision of other safeguards and the reporting of accidents. Even in this field, however, from its original immersion in overcoming opposition and enforcing extensively

* Factories and Workshops. Annual Report of the Chief Inspector of Factories and Workshops for the Year 1932 (including a Review of the Years 1833 to 1932). Pp. 134. (London: H.M. Stationery Office, 1933.) 2s. net.

the observance of the law by fines, the work of the inspectors soon became largely advisory. Their services were freely sought as technical advisers not only to solve questions of safety and fencing but also to elucidate the law; and in the last fifty years, above all in recent decades, the greater part of the invaluable services of the inspectors has been rendered in such ways as this. They have been less occupied with the maintenance of legal standards than in assisting industry to adjust itself to the rapid changes induced by mechanisation and other influences.

As the report observes, "the technical study and improvement of detailed methods of safeguarding against mechanical and other dangers has during the present century continued and developed as one of the most important functions of the Factory Department". Even the increased tendency to prescribe some of these detailed methods by statuary regulations may be regarded as an effort to translate into practice, for the general benefit, experience acquired in particular sections of industry. From this point of view the work of the inspectorate represents not merely a most important method of bringing scientific thought and research to bear on the improvement of industrial conditions, but also a striking example of industrial co-operation in the pooling of knowledge on matters common to many industries. The work of the inspectors has undoubtedly paved the way for the "Safety First" movement; the discussion of industrial safety by the International Labour Organisation in its conferences of 1928 and 1929 would have been almost inconceivable apart from the pioneer work of the factory inspectors in Great Britain and in other countries.

The activities of the inspectors in the field of industrial health and welfare illustrate the same tendencies, and the section reviewing this field is one of the most impressive in the whole report. It was long before it was realised that medical science could assist in the improvement of working conditions in industry, and the conscience of the medical profession during these early days was itself not sufficiently awake to realise its opportunities or responsibilities. Some surgeons indeed were willing to give false certificates of age deliberately, and thus to obstruct the inspectors in their task of restricting the employment of children below the legal age. For all that, State intervention to secure preventive measures against industrial diseases was so long delayed, protests were early made against the unhealthy conditions which prevailed and even in 1861–62, Sir John Simon, the Medical Officer of the Privy Council, asserted: "The canker of industrial disease gnaws at the very root of our national strength."

The way in which effective action has been organised so that scourges like those due to phosphorus necrosis, lead poisoning and anthrax have been largely or entirely eliminated, and the incidence of other diseases such as occupational cancer and silicosis reduced, would alone have justified the existence of the inspectorate. Experience gained in this way has led to the elaboration of precautions in dealing with dusts, poisonous vapours and toxic substances, as well as to the introduction into factory life of improved sanitation, ventilation and hygienic conditions of inestimable value in dealing with the new problems which have arisen with the growth of new industries.

The report indicates emphatically that, in the field of health at all events, there is no finality in the work of the inspectorate. The task is dynamic and not static. Apart from the two very important diseases, fibrosis of the lung and cancer, "the post war period has been one of anxiety as to the dangers from the use in industry of complex chemicals used, for example, as solvents of cellulose and in the manufacture of synthetic compounds. New industries have brought their problems—the manufacture of artificial silk giving rise to a new source of carbon disulphide poisoning and producing conjunctivitis from the hydrogen sulphide evolved in the spinning rooms, while chromium plating, a labour saving invention, has increased the risk of chrome ulceration: . . . it is inevitable that in an age of rapid progress modern methods with their attendant risks have supplemented old methods; thus we find the spraying of paint taking the place of the brush method and cellulose solutions replacing paint, methods of work all calling for inquiry as to the existence of any special risks and the necessity for special preventive measures for the protection of workers."

These are developments which emphasise the necessity for the constant application of scientific knowledge and research; but one of the most impressive features of the present time is the extent to which such research is initiated by industry itself. The appointment of safety officers, of works medical officers and the like, leads to the systematic investigation of conditions of work which go far beyond anything that could be enforced or inculcated by legislation. The full resources of technical knowledge and experience available are brought to bear on an unusual accident or outbreak of poisoning, so regularly and so much as a matter of course, that frequently the inspectorate can only approve the measures already taken.

That to a considerable extent the initiative in this field has passed from the inspectorate to the industrial organisations themselves is no reflection on the present department. On the contrary, it is the finest tribute to the success of its work and the ability with which its duties have been discharged. That in the space of a hundred years, with industry changing its scale and character at a steadily increasing rate, such a revolution in the whole spirit of industry has been effected, is an achievement which demands consideration, and a large share of responsibility for the change lies on the shoulders of the inspectorate.

Other factors undoubtedly have played their part—the growing dissatisfaction with *laissez faire*

as a principle of industrial or national policy, a growing respect for human life and personality, the revolution in the human outlook produced by the War—but this contribution of a relatively small band of technical officers is so significant as to merit the closest attention. On the face of it, these officers have built up a strikingly successful department of State, the organisation of which has formed a model for many other Government departments so far as inspection work is concerned. This in itself is a striking testimony to the capacity for administrative work of scientific officers in Government service, and should dispose of any argument that the scientific worker as such is incompetent to handle the real problems of national or industrial life.

Even more impressive, however, is the essential characteristic of this hundred years' work—the evolution of a means by which scientific officers can render technical service to the State and to industry on terms which permit them to retain their professional independence and integrity. This is the fundamental feature of the system and it possesses profound significance for our present industrial and social if not international order. The continuous growth in importance of technical factors in all first class industrial, social and national issues makes the contribution of the technical expert more and more important. That contribution must be unbiased, must be inspired solely by a spirit of service and of loyalty to the highest professional ideals, or civilisation is doomed. Add to this the steady passing of industrial control into professional hands, or at least into the hands of those increasingly accessible to professional influence, and the significance of the situation can scarcely be missed. The transfer of the initiative in matters of industrial health and safety into the hands of industry leaves it largely in the hands of the same professional classes of chemists, engineers, medical officers and others from whose ranks the inspectorate itself is recruited. The future welfare of industry, as of the State, depends on the zeal and integrity with which the ideals so consistently pursued by the inspectorate independently are served by those in the direct service of industry. The records of the past hundred years set forth in the present report afford every justification for confidence that this trust will not be betrayed, and for the expectation that scientific workers in the service of industry or of the State have yet larger contributions to make to the advancement of the commonweal and the control of the awe-inspiring forces which man's inventive ingenuity has released.

Obituary

PROF. L. J. ROGERS, F.R.S.

LEONARD JAMES ROGERS held the chair of mathematics at the Yorkshire College and University of Leeds from 1888 until 1919. He then retired after a severe illness to Oxford, where he had been born and educated; and he died there on September 12.

Rogers' reputation as a mathematician rests almost entirely on a single incident. It is told in full in Ramanujan's collected works; but it is so extraordinary and characteristic that it will stand telling again. In 1913 Ramanujan, an Indian clerk without any higher education, astounded mathematicians by presenting them with a long list of remarkable propositions that he claimed to have discovered. On examination some of them proved old; many could be proved (and a few disproved) by standard methods; but some remained doubtful. Among these were two simple but beautiful propositions, of which one alone need be stated. It was

$$1+\frac{x}{1-x}+\frac{x^4}{(1-x)(1-x^2)}+\frac{x^9}{(1-x)(1-x^2)(1-x^3)}+\cdots$$
$$=\frac{1}{(1-x)(1-x^6)(1-x^{11})\ldots}\times\frac{1}{(1-x^4)(1-x^9)(1-x^{14})\ldots}$$

Ramanujan, even when his powers were developed by education at Cambridge, could not prove them; nor could MacMahon, the leading English authority on the subject, who devoted to them a whole chapter of his treatise "Combinatory Analysis". Later, Ramanujan, searching for something else in old *Proceedings of the London Mathematical Society*, found that Rogers had stated and proved them in 1894; he had lost interest in the subject so completely that he either had not heard of Ramanujan's work or did not think it worth while to direct attention to his own. Of course, the rest of Rogers's work was carefully studied; but, though everything he wrote was marked by a certain distinction, nothing else of first-rate importance was discovered. He was elected a fellow of the Royal Society in 1924, and relapsed into his former obscurity.

To all who knew him but slightly, that incident must appear typical of Rogers. Fine abilities, they would say, wasted by freakishness and inconstancy! The first part of this judgment is beyond dispute. Rogers' major abilities can seldom have been excelled in extent or variety; and his minor accomplishments ranged from knitting to skating. Merely to catalogue all the things he might have done would be a long task. Perhaps science was the only field from which he was naturally debarred; that was definitely antipathetic; in the garden that he tended with love and skill he would tolerate no science more modern than Linnæus. Certainly he might have won great fame in music, either as scholar or executant; and surely no position in diplomacy would have been unattainable to one endowed with his easy mastery of languages, his quick intelligence, his sparkling wit, his fine presence, his athletic grace, his courtly charm that no

woman could resist. Yet of what the world counts success he achieved practically nothing.

Perhaps then it is useless to dispute the second part of the judgment. To those for whom energy and determination are the first virtues, and dilettantism the last crime, Rogers was exasperating. But when they came to know him intimately, they must sometimes have been doubtful of their values. Would the world have lost or gained, if the full development of his powers had meant the sacrifice of his simple cheerfulness, his generous capacity for friendship, his infinite tenderness and kindness? N. R. C.

Sir John Biles, K.C.I.E.

Sir John Biles, whose death on October 27 at the age of seventy-nine years we regret to record, will always be remembered as a designer of Atlantic liners, and for his thirty years' work as professor of naval architecture at the University of Glasgow. He was one of the many naval architects who, after being trained under the Admiralty, have done important work in connexion with mercantile ship-building.

Born at Portsmouth on January 6, 1854, John Harvard Biles became a shipwright apprentice in the dockyard there, and gaining a scholarship in 1872, became one of the last students to enter the old Royal School of Naval Architecture and Marine Engineering at South Kensington. In 1873 he passed to the Royal Naval College, Greenwich, and a few years later, as a junior naval constructor, he was employed on the construction of the remarkable steel cruisers, H.M.S. *Iris* and H.M.S. *Mercury*. In 1880 he joined the firm of Messrs. J. and G. Thomson of Clydebank, now John Brown and Co., Ltd., which quickly became the rival of the Fairfield firm founded by John Elder. While Pearce at Fairfield built the *Alaska* of 1881, the *Oregon* of 1883 and the *Umbria* and *Etruria* of 1884, Biles at Clydebank produced the *Servia*, the first steel ship of the Cunard Company, the *Aurania* and the *America*, in which speeds ranging from 17 to 20 knots were obtained with a considerable reduction in coal consumption. He attained still more remarkable results with the *City of Paris* and *City of New York*, each of which was driven with twin screws. The *City of Paris* was the first vessel to cross the Atlantic in less than six days. In 1885 Biles also constructed the Spanish torpedo-boat *El Destructor*, which is sometimes regarded as the forerunner of the torpedo boat destroyer.

Resigning his appointment at Clydebank, in 1891 Biles was elected to the chair of naval architecture at Glasgow, previously held by Elgar and then by Jenkins, and this post he retained until 1921. At the time of his retirement it was said that "the Glasgow School of Naval Architecture is now the largest, best equipped and most famous in the world, attended, as the Mecca of the shipbuilding industry, by a polyglot crowd of eager students from most of the civilised nations of the globe". For many years Biles was also consulting naval architect to various steamship companies, and at times served as a member of important Government committees, including the famous Designs Committee of 1904–5, which led to the building of H.M.S. *Dreadnought*. During the War he did much valuable work in connexion with river craft for the Mesopotamian campaign.

Sir John Biles's books, papers and lectures covered a great range of subjects, while his services were honoured both at home and abroad. He was knighted in 1913 and made K.C.I.E. in 1922. During recent years he was senior partner in the firm of Sir J. H. Biles and Co., naval architects and engineers, carrying out important consulting work.

Mr. W. J. Harding King

We regret to record the death of Mr. William Joseph Harding King, well known as an explorer and authority on the Libyan Desert and its peoples, which took place recently at Honiton at the age of sixty-four years.

Mr. King was the son of Mr. William Hartley King of Wollescote Hall, Stourbridge, and was educated at Trinity College, Cambridge. The results of his first journey of exploration in the western Sahara in 1900 were given to the world in his book "In Search of the Masked Tawareks", published in 1903. This was the first account of the Tuareg in English since Barth's work had appeared more than half a century before, and its value, at a time when the literature relating to this little-known people based on first-hand knowledge was almost non-existent, was considerable. Further exploration followed in the Sahara in 1908 and from 1909 until 1912 in the central parts of the Libyan Desert. In 1913 Mr. King joined the late Oric Bates in the archæological exploration of Marmarica in North Africa. His most important book, "Mysteries of the Libyan Desert", appeared in 1925. In this he gave an account of his penetration to the central area of the Libyan Desert, notwithstanding Senussi opposition, and of the valuable geographical, ethnological and archæological material then recorded. Mr. King contributed a large number of papers on his investigations to scientific periodicals, and was awarded the Gill Memorial Medal by the Royal Geographical Society in 1919.

We regret to announce the following deaths:

Prof. L. C. A. Calmette, For. Mem. R.S., assistant director of the Pasteur Institute, Paris, known for his work on tuberculosis, on October 29, aged seventy years.

Sir Alexander C. Houston, K.B.E., C.V.O., F.R.S., Director of Water Examinations, Metropolitan Water Board, since 1905, on October 29, aged sixty-eight years.

M. Paul Painlevé, the distinguished mathematician who was three times Prime Minister of France, on October 29, aged sixty-nine years.

News and Views

Commemoration at the University of Edinburgh

LAST Friday and Saturday (October 27 and 28) the three hundred and fiftieth anniversary of the foundation of the University of Edinburgh was commemorated. The University was founded as "The Town's College" and, until seventy-five years ago, continued to be governed by the City Corporation, so that it was specially appropriate that the celebration should begin with a reception given on Friday evening by the Lord Provost and magistrates of the City of Edinburgh. The Lord Provost, in tendering the greetings and good wishes of the Corporation, referred to the close and cordial relations existing between the City and the University. The Chancellor, Sir James Barrie, thanked "the City Fathers". On Saturday morning a graduation ceremonial was held at which were present delegates from the Royal Societies of London and Edinburgh and the British Academy, from more than twenty universities and from the University of Edinburgh clubs and associations in various parts of Great Britain.

HONORARY degrees were conferred on distinguished representatives of the church and of science and letters. Among the former was the Archbishop of Canterbury and among the latter the principals of the other three Scottish universities, Sir Edward Sharpey-Schafer, who has just retired from the Edinburgh chair of physiology, Sir James Crichton Browne, the oldest graduate of the University, who obtained his medical degree in 1862, Miss Frances Simson, one of the first women graduates of the University, Lord Rayleigh, Prof. van Blom, Rector of the University of Leyden, and M. Emile Legouis, formerly professor at the Sorbonne. At noon, Sir Thomas Holland broadcast an address to the 19,000 graduates who are scattered throughout the Empire. A commemoration service was held in St. Giles' Cathedral at which the preacher was the Very Rev. Sir George Adam Smith, Principal of the University of Aberdeen, who graduated at Edinburgh in 1875. After lunch in the University Union, many of the guests visited the Old College. The celebrations concluded with a reception given by the University Court and Senatus in the McEwan Hall. The neighbouring Anatomical Museum and some of the departments in the medical building were open for inspection of their special features.

IN the autumn issue of the *Journal* of the University of Edinburgh (Oliver and Boyd, Tweeddale Court, Edinburgh, 1*s*.) there is a number of reminiscent articles appropriate to the occasion: Sir James Barrie contributes a characteristically whimsical note on Thomas Carlyle; Dr. David Rorie gives, under the title "The Weighty Eighties", a series of thumb-nail sketches of professors of the University in the decade 1880–1890; and Augustus Muir in "The Old Quadrangle" recalls impressions of Profs. Whittaker, W. G. Smith, Baldwin Brown and George Saintsbury. Saintsbury, who was professor of English literature in the University from 1895 until 1915, is the subject of a long (40 pages) biographical memoir by the present occupant of the chair, Prof. Blyth Webster, who thus concludes an estimate of his work as lecturer: "He was not finished or exhaustive. Better so. The too good lecture may miss its mark. He set us on the quest, opened vistas, kindled the passion, put clues into the hand, and bade us follow Knowledge like a sinking star. *Nos manet Oceanus.*" A "History of the University of Edinburgh, 1883–1933", a volume supplementary to Sir Alexander Grant's "Story of the University" prepared in association with the tercentenary celebrations of 1883, has just been published by Messrs. Oliver and Boyd.

The Ionosphere in Polar Latitudes

AT the Friday evening discourse delivered at the Royal Institution on October 27, Prof. E. V. Appleton described aspects of the work of the second International Polar Year. It is now known that there is an intimate connexion between magnetic storms, displays of the northern lights, and electrical currents in the upper atmosphere. Radio methods of sounding the electrified regions of the atmosphere have been developed in Great Britain, and the Polar Year Committee, besides sending out an expedition to Fort Rae in Canada, recommended that a radio expedition should also be sent to Tromsø in northern Norway. The work of this party showed the marked difference between wireless transmission conditions in latitude 70° and in south-east England (see NATURE of September 2, p. 340). During the powerful magnetic disturbances which take place in Tromsø, it was found that the ionised layer of the upper atmosphere ceased to reflect, thus making long-distance communication by short waves difficult, if not impossible. Such blank periods have a tendency to recur after 27 days, which is the time required for the sun to make one revolution. This result makes clear some of the anomalies which have been noticed in polar exploration. It will be remembered that in the case of General Nobile's polar flight in the airship *Italia*, there were two periods separated by about 27 days when wireless communication between the airship and the outside world was interrupted. It is clear from the records that these were both periods of intense magnetic activity during which we now know that radio waves are absorbed and not reflected by the upper atmosphere. The results of the British radio expedition therefore clearly indicate that if radio is to be used in polar exploration, note must be taken of this monthly sequence of unfavourable conditions. It would also be advisable to choose a year of sunspot minimum, and not a year of sunspot maximum as in the case of the ill-fated *Italia* expedition in 1928, since magnetic and wireless disturbances are relatively less marked when the spots on the sun are few.

As regards the constitution of the reflecting layers in the upper atmosphere, Prof. Appleton pointed out that the results obtained show conclusively that

the main cause of the electrification in both layers is the ultra-violet light of the sun, and in magnetically quiet conditions (no magnetic storms) this electrification is actually less in the arctic regions than in England. While the normal undisturbed conditions fit in with the ultra-violet light theory, the conditions during magnetic disturbances and auroral displays can only be satisfactorily explained on the assumption that the electrification spreads to abnormally low levels because of the influx of particles from outside the earth's atmosphere. Experiments arranged by Mr. R. A. Watson Watt in the Library of the Royal Institution after the lecture well illustrated the behaviour of these incoming particles when influenced by the magnetism of the earth. Streams of electrons in a vacuum tube striking a magnetic model of the earth near the poles avoid the tropics, being caught up and deflected by the earth's magnetic field. The very complicated paths followed by the electrons —often looping back on themselves—realistically imitated auroral displays. The actual receiver used by the Arctic Circle expedition was shown in operation in measuring the height of the reflecting layers over London by using pulses of energy emitted from King's College, London.

The British Grid and Underground Distributing Cables

MR. P. V. HUNTER, in his presidential address to the Institution of Electrical Engineers on October 26, said that during the last ten years the electric supply of Great Britain has more than doubled. It seems to be increasing at a practically constant rate. The small setbacks that occurred in the growth of supply were quite definitely due to political uncertainty at those periods, but were more than counterbalanced by the 'boom' year of 1929. The progress of the 'grid' is quite up to expectations and the country will soon be greatly benefited by it. Uncertainty still exists as to whether to use 11,000 volt underground cables or overhead wires for rural electrification from the grid. Mr. Hunter said that in many cases it would be advisable to run cables across country. In this case it is much less costly to maintain them than when they are laid in public roads. A special type of rural cable for 11 kilovolt working could be standardised. If this were done, it would be much cheaper to manufacture and would result in economies in many directions. In Holland, rural areas have been developed by 10,000 volt underground cables on a vast scale, more than 10,000 miles of such cable having been already laid. The network covers practically the whole country. So far as freedom from interruption and voltage variation is concerned, the supply is most satisfactory and the prices charged for electricity in rural districts are quite reasonable. The annual cost of repairs is less than 0·5 per cent of the original capital cost and is not a growing percentage. This is most satisfactory, as much of the cable is more than ten years old and, compared with modern practice, the sheaths are poorly protected against corrosion. The Dutch are convinced that underground cables are a great success and will undoubtedly continue to use them. In conclusion, Mr. Hunter gave an instructive résumé of the vast amount of scientific work done in connexion with very high voltage cables.

New Lamp for Street Lighting

A VERY interesting new type of lamp, called the Osira, has been developed in the G.E.C. Research Laboratories at Wembley. It is intended for use in lighting stretches of arterial and country roads where the illumination required is not high and so the lack of good colour discrimination is of little importance. Blues, greens and yellows appear as in daylight, but red colours appear brownish. The lamp takes 400 watts and has an efficiency more than double that of a corresponding gas-filled tungsten lamp taking the same power. In the *G.E.C. Journal* for November, Mr. J. W. Ryde gives a technical description of the lamp. It consists of two cylindrical bulbs one inside the other. The inner bulb contains rarefied gases at low pressure and a trace of mercury. The space between the bulbs is vacuous. The electric discharge takes place between electrodes sealed in each end of the inner bulb. The electrodes consist of small sticks of alkaline earth oxides which have been heated to a high temperature during the process of manufacture. This is done by passing a current through spirals of wire surrounding the electrodes. They are then connected with an ordinary screw cap holder. When the voltage is applied, a discharge takes place through the rarefied gases in the volume of the inner bulb. As this bulb warms up, the mercury is volatilised. The discharge then begins to contract and finally takes the form of a narrow column, six inches long, extending between the electrodes. The electrically excited atoms in this column emit a brilliant light and are the counterpart of the filament in the glow lamp.

THE new lamp lights up automatically when switched on, no devices are required for starting the discharge and no filament transformers are required for heating the electrodes. It is connected directly to the alternating current supply mains in series with a choking coil. A condenser is sometimes placed across the mains so as to raise the 'power factor' of the load, but this does not affect the performance of the lamp itself. In this type of lamp, the current is carried by ions and its effective resistance depends on their number. The ions, which are negatively charged electrons and positively charged atoms, are formed by the discharge itself at a rate which increases with the current. They re-combine with extreme rapidity and so again form normal atoms. The resistance of the bulb at any moment depends on the current passing. The lamp resistance therefore does not remain constant when the voltage is changed. In a similar way the resistance of an ordinary incandescent lamp changes with its temperature. If there were no choke coil present, the current would rise to a very high value and the lamp would break down. A change of one per cent in the supply voltage corresponds to a 2·6 per cent change in the power taken and to a 3·5 per cent change in the light. In the gas-filled tungsten lamp, the corresponding

changes are 1·6 per cent and 3·9 per cent respectively. The Osira lamps run at the standard pressure of 230 volts. A mile of the Watford Road, Wembley, is lit by them. The sudden change from ordinary lighting to Osira lighting is rather a shock when driving along the road, but doubtless the colour deficiency will soon be improved.

Schemes for National Re-Equipment

IN the opening passages of his presidential address to the Institution of Mechanical Engineers, delivered on October 27, Mr. A. E. L. Chorlton, M.P., said that the old *laissez faire* policy of the Victorian era belongs to an age now gone by and that to-day more co-ordinated direction and control of public services is necessary in Great Britain if we are to increase the general facilities for industry and the amenities of social life. The various public services of the country, light, heat, power and water supply were all developed separately with but little inter-connexion, but it is now agreed that if they had been properly inter-related, a much more efficient system would have resulted at a far smaller first cost. Taking water supply as an example, Mr. Chorlton went on to show how by suitable trunk pipe lines the water from areas with heavy rainfalls could be used to supplement the present supplies. It is imperative that the whole of the available water supplies of the country should be investigated, and a scheme developed somewhat on the lines of the electricity scheme. There are also many arguments for the inter-connexion of existing gas undertakings by a 'gas grid', among which is that the development in many areas of coke-oven installations makes available large quantities of gas. Mr. Chorlton was able to give emphasis to his views by reference to long-distance transmission schemes for water and for gas abroad, and incidentally mentioned that Chicago obtains its gas supply from the oil fields of Texas a thousand miles away. Speaking of the 'electric grid' in Great Britain, Mr. Chorlton said that it is the largest thing of its kind in the world and in the supply and distribution of electricity we are now in the forefront. There are many other schemes of national re-equipment which need investigation and in which mechanical engineers can play an important part. With reference to Mr. Chorlton's remarks on water supply in England, we may direct attention to his article on this subject published in *Engineering* of October 13 and 27.

Identification of Coronal Lines

A MESSAGE from its New York correspondent published by the *Times* of October 27 states that Drs. D. H. Menzel and J. C. Boyce have identified some of the well-known coronal lines. These lines, which occur in the spectrum of the solar corona, have remained unidentified for several decades, and were at one time supposed to indicate the presence in the corona of a new element, which was called coronium. This hypothesis had, of course, the precedent of the discovery of the element helium by the same method to support it, but of recent years it has not been usual to suppose that the actual element coronium exists. A few years ago, Bowen identified the nebulium lines. These lines, which appeared as very strong emission lines in the spectrum of nebulæ, were shown to be 'forbidden' lines in the iron spectrum. They are lines which do not appear in ordinary circumstances, but in the peculiar conditions of low density which obtain in nebulæ, the atom remains undisturbed in an excited state for a relatively long time, and has an opportunity to make the 'forbidden' transition. It became natural to suppose that the 'coronium' lines are also forbidden lines in a spectrum, the corona being at a very low pressure. Despite an exhaustive search for the required frequency intervals in known spectra, nothing had been found until recently. According to present announcement, Menzel and Boyce have now found the required intervals among the terms in the oxygen spectrum. It will be recalled that these coronal lines have been detected in the spectrum of the recent nova in Ophiuchus.

Recent Acquisitions at the British Museum (Natural History)

THE Department of Zoology of the Museum has received some valuable specimens as the result of a cruise made by Mr. F. C. Fraser, of the Department, who, on the invitation of Col. E. T. Peel, accompanied the latter in his yacht to the north of Scotland, the Shetland Islands, and the Faröe during July. Mr. Fraser was able to make many observations on living dolphins and porpoises, and to secure excellent photographs, of which enlargements are now being prepared for exhibition in the New Whale Hall. A number of young birds and eggs were collected on the Faröe and the Shetland Islands, in particular a young specimen of the Arctic skua. A collection of some 8,500 insects, chiefly butterflies and moths, collected in Malaya by the late A. R. Sanderson, has been purchased for the Department of Entomology. The collection contains many specimens of value to the Museum particularly in connexion with the study of the geographical distribution of insects. A series of plant fructifications from Triassic rocks of South Africa, recently described by Dr. Hamshaw Thomas, and regarded as being Mesozoic representatives of the typically upper Palæozoic group of Pteridosperms, also a number of specimens of fungus-gnats and of small flowers in Baltic amber, have been purchased for the Department of Geology. The series of books on precious stones in the library of the Mineral Department has been added to by a valuable donation from Mr. Edward Heron-Allen of twelve volumes from his private library. The most interesting of these is an early edition, printed in Freiburg in 1531, of "De lapidibus pretiosis enchiridion", written in Latin verse by Marbode (1036–1123), Bishop of Rennes.

THE Department of Botany has had bequeathed to it the herbarium of the late C. C. Lacaita. Mr. Lacaita was well known for his wide interests and had a very considerable reputation as a European botanist. A few years ago he presented his mono-

cotyledons and Sikkim plants to the Department. The present collection is estimated at 40,000 sheets, in excellent condition and order. Its chief value is in Mr. Lacaita's own gatherings from various parts of Europe but particularly from Italy and Spain—areas not over-well represented in the herbarium. There is further abundant material of those genera in which he had specialised, such as *Helianthemum*, *Echium*, *Onosma*, *Pulmaria* and *Cirsium*. The collection also contains a number of exsiccata, some of which were not previously represented in the Museum collections. Mr. A. H. G. Alston, assistant keeper in the Department, visited southern Albania in the summer in company with Mr. N. Y. Sandwith, of the Kew Herbarium. They explored many districts from which no previous collections are known. About a thousand different plants were collected. Although these have not yet been worked through, they evidently include many rare and little-known species. The collection, in conjunction with that made in Macedonia last year, will give a good deal of information about plant distribution in the Balkan Peninsula. Mr. G. Tandy, assistant keeper in the Department, has again visited the Tortugas, Florida, and has collected about 650 numbers. These contain a very interesting series from experiments on growth-forms of species of *Caulerpa*, which will yield valuable taxonomic results. Mr. J. Gossweiler has presented a further 433 specimens of Angola flowering plants.

Friends of the National Libraries

THE Friends of the National Libraries, a body formed in 1931 to promote and assist in the acquisition by the national libraries of important works and manuscripts, has issued its second annual report, covering the year ending March 31, 1933 (Friends of the National Libraries, c/o British Museum, W.C.1). It is obvious that the main task of such a society must be to fill the gaps existing in the great collections of the British Museum, the Bodleian, and the other national libraries of Great Britain, and it is therefore all the more gratifying to find from the present report that the interests of the smaller and the special libraries are not being overlooked, and that many of the works secured during the year have gone to them. A notable example is the acquisition by the Royal Entomological Society of the first nine numbers of its own early *Journal of the Proceedings of the Entomological Society of London*, 1840–1846. Only ten numbers of this journal were issued (the *Proceedings* were incorporated with the *Transactions* from 1847 until 1926), and though copies were widely distributed at the time, they seemed to have become exceedingly rare and have for long been included in the desiderata of the Society's library.

AMONG other gifts of the Friends of the National Libraries, we find that four Linnæus items, including a unique copy of the fourth edition of Rousseau's "Letters on the Elements of Botany", 1794, have gone to the Natural History Museum, whilst the Science Library has benefited to the extent of more than a hundred volumes on navigation and kindred subjects. The latter formed part of a collection of books placed by the Corporation of Trinity House at the disposal of the Friends of the National Libraries for distribution, and show the Society in its secondary rôle—as a clearing-house for unwanted and duplicate books. This is a service that should be widely known and utilised, for it provides the only means whereby works of mainly local or other special interest can find a permanent home in the libraries most fitted to receive them. The excellent record of work shown in this report deserves to be copied, and it may be suggested that 'friends of the national museums' should similarly organise themselves to help the Science Museum and others to add to their collections.

Chemical Engineering, Past and Present

PROF. G. T. MORGAN, director of Chemical Research under the Department of Scientific and Industrial Research, delivered a lecture before the Institution of Chemical Engineers on October 27 entitled, "Engineering in the Service of Chemical Research". Prof. Morgan is one of the exponents of high pressure chemistry, in which strong steel containers or autoclaves replace the glass test-tubes of the chemist. He described his successes at the Chemical Research Laboratory with pressures of 200 atmospheres at 450° C. in inducing methyl alcohol and carbon monoxide to combine in the synthetic production of acetic acid. Apparatus has now been devised by which experiments can be carried out on pressures of 3,000 atmospheres, that is, about 20 tons per sq. in. The pressure-resisting parts for this plant are made from Sheffield nickel chromium molybdenum heat-treated steel. The plant is enclosed within steel screens so arranged that the various controls are operated from outside this protection. At the other extreme, constituents of coal tars difficult of separation are being obtained at the Laboratory by distillation of the tar at very low pressure (of the order of a thousand millionth of an atmosphere) in a plant in which the cold condensation surface is placed so near the substance being distilled that its molecules escape direct to the condensing surface without contamination.

PROF. MORGAN demonstrated the efficiency of a new wetting agent for mercerising cotton, developed at the Laboratory from coal-tar products, which is now being marketed under the name of Shirlacrol. He also described a new ether extracting plant, developed at the Laboratory, by which a Yorkshire firm is now successfully manufacturing resorcinol, a 'fine' chemical of considerable industrial importance, supplies of which have hitherto been entirely imported from abroad. All industrial applications of chemical science, engineering and chemistry are mutually indispensable and, so far as Great Britain is concerned, the advantages of such co-operation are more generally recognised to-day than they formerly were, but there is room for much improvement. Opportunities are boundless but without a closer collaboration between chemistry and engineering, we must certainly drift into the position of a

navvy nation—hewers of wood and drawers of water for more educated peoples. In certain respects Great Britain was approaching that position in 1914. The War gave us a temporary respite, but the never-ending economic industrial struggle is still with us, and in this contest the intimate blend of chemistry and engineering presented by the Institution of Chemical Engineers must take an increasingly important part.

Elm Disease in Great Britain

A FURTHER survey to determine the course of elm disease in Great Britain was carried out recently by Mr. T. R. Peace, of the Imperial Forestry Institute, Oxford, on the instructions of the Forestry Commissioners. Three counties have now to be added to the list of those in which the disease is known to occur, namely Durham, Derbyshire and Dorset. The characteristic symptoms of elm disease, namely die-back of the crown, appeared this year rather earlier than usual and by the end of July so many cases were seen that a heavy attack appeared probable. Surprisingly few further cases, however, developed during August and September and the final result may be stated as showing a definite increase over 1932 but a decrease as compared with 1931. The general position in England is unchanged from that of previous years. The disease remains serious in parts of the eastern counties ; but severe damage is of local occurrence. In the South Midlands and in the south eastern counties the disease is frequent but seldom serious. Towards the west and north it is sporadic and has not been found north of a line between Durham and Chester, in the western counties of Wales, or in Cornwall. Having regard to the recent dry summer, it may be considered satisfactory that the disease has not spread more rapidly or done a larger amount of damage than appears to be the case. An interesting observation made during the course of the survey relates to the north of England and Scotland. Many of the older trees, mostly wych elms, showed signs of die-back closely resembling those caused by the elm disease, but distinguished from the latter by the absence of the characteristic markings in the twigs and by one or two more general characters such as the browning of the leaves round the edges. The cause of the trouble, which is widespread, is under investigation.

The Communication Revolution, 1760–1933

AFTER the delivery of the presidential address by Mr. H. W. Dickinson to the Newcomen Society on October 11, a paper with the above title was read, by Prof. R. G. Albion of Princeton University. Taking the opening of Brindley's Bridgewater Canal as his starting point, Prof. Albion touched upon the development of canals, roads, railways, steamships, telegraphs and submarine cables, electric traction, motor-cars, telephones, aeroplanes and radio, and briefly referred to the effect of the 'communication revolution' on commerce, finance, exploration, colonisation, government, warfare, city growth and also to its influence on the individual. His paper contained many interesting comparisons of the facilities for communication in the eighteenth century and to-day. Just as stage coaches in England sometimes took 14 days to go from London to Edinburgh, so travellers were often a week going from Boston to New York, while one landmark in colonial travel was the inauguration in 1770 of a two-day service between New York and Philadelphia, a distance of but 90 miles. The first shots in the American Revolution were fired at Lexington on April 19, 1775, and the news did not reach New York, 225 miles distant, until four days later. The United States, Prof. Albion said, would probably have never fought England in 1812 had there been an Atlantic cable, for England suspended the Orders in Council, the chief American grievance, the day before War was declared at Washington. Rapidity of communication has also revolutionised business transactions, and although the Rothschilds once maintained an elaborate service of correspondents and couriers for business purposes, their information was neither so full nor so fresh as that found in any daily paper to-day. Speaking of newspapers, films and radio as the means for "mass communication" Prof. Albion said that the chief implied danger of these is that their great influence may be abused by the small groups which control them.

Work of the Government Chemist

THE report of the Government Chemist on the work of the Government Laboratory for the year ending March 31, 1933, shows that the total number of samples examined, nearly 461,000, was smaller by about 12,000 than last year's figure. Work actively progressed in the elucidation of new and improved methods, and in the technique of examination of materials becoming subject to new duties. For example, orders are made from time to time under the Import Duties and Ottawa Agreements Acts which involve changes in the incidence of duty and require the carrying out of many difficult analyses, of a wide range of products ; moreover, such analyses frequently require investigation and general inquiries before decisions can be reached. Among the specific investigations mentioned is one group on Trinidad natural gas, which was found to contain only negligible traces of helium. In 20 instances out of 105 samples of non-alcoholic beer, herb beer, and beer substitutes examined, the alcohol ranged from 2 to 6 per cent of proof spirit. Samples of storm water taken from surface water drains in London districts were examined chemically and bacteriologically in connexion with an inquiry into the character of the water concerned ; the examination of numerous samples of sea-water has also been continued as a share in an international scheme for the collection of data for hydrographic research. Another phase of the work is designed to ascertain the condition of fishing streams from the point of view of fish life, and the effect of certain types of pollution on fish food. Reference is again made to the fact that since there are no regulations relating to the marking of skimmed or partly skimmed milk cheese, and since there is no standard for cream in Great Britain, no exception could be taken to deficiencies in the fat content of these foods.

Trochus and Pearl-Shell in Queensland Waters

In vol. 4, pt. 1 of the Report of the Great Barrier Reef Committee (Brisbane: Government Printer), Mr. F. W. Moorhouse deals with products of economic importance—green turtle, *Trochus* and sponges. His work on the life-history of the turtle is referred to elsewhere in this issue (p. 715). As regards *Trochus*, there is little fresh work reported, but the question of size limits is discussed, 2½ in. in greatest basal diameter being regarded as essential. Shirt buttons having red, brown or greenish markings on their under sides are made from *Trochus* shell. The shell and button industry for the last few years has been more or less out of commission all over the world, owing to the dictates of fashion and the economic depression, so that probably the matter of size restriction is not urgent. Would it not be well for Queensland to consider the development of the farming of the much more valuable pearl-shell in its waters? A single farm in full operation might quite well produce 1,000 tons a year, which is more than the average catch of the last ten years in all Queensland waters. Such a farm might as a side-line develop the planting out and growth of sponges as Moorhouse has shown.

The Sky in November

This month is marked by the appearance of two notable meteor showers, the Leonids and the Andromedids. The Leonids appear from November 9 until November 20, the greatest display being on November 14 and 15. The radiant is at 10 hours R.A. and +23° declination, so that the meteors will only be visible immediately before sunrise. The Andromedids appear from November 20 until November 30, the greatest display being from November 20 until November 23. The radiant is at 1 h. 40 min. R.A. and +43° declination. As the sun's right ascension is about fifteen hours at this time of year, the display is well placed in the eastern evening sky. Venus reaches its maximum eastern elongation on November 25. It will be very bright—its magnitude will be −4·1—and the planet will be about 23° above the horizon at sunset. Mars will set about two hours after the sun in the middle of November.

Announcements

It is announced that His Majesty the King, accompanied by the Queen, hopes to open the New Medical School of St. Mary's Hospital, Paddington, London, on December 12.

The Medical Research Council has appointed Prof. E. P. Cathcart, of the University of Glasgow, to be chairman of the Industrial Health Research Board in succession to Sir Arnold Wilson, who has resigned on becoming a member of Parliament. Prof. Cyril Burt and Miss Hilda Martindale have been appointed members of the Board in succession to Sir John Parsons and Miss M. Ritson, who have retired in rotation.

Achema VII, the well-known German exhibition of chemical apparatus and plant, will be held in Cologne on May 18–27, 1934, simultaneously with that of the German Chemical Trades Association ('Dechema'), and with important conferences of leading trades associations and technical societies. Information can be obtained from 'Achema', Management Offices, Seelze, near Hannover.

British Drug Houses, Ltd., have issued the third edition of the pamphlet "P_H Values" and also a new catalogue of indicators, accessories and outfits for the determination of hydrogen ion concentration. The former is very practical and informative, and the catalogue is very comprehensive. Copies may be obtained from the firm, Graham Street, N.1.

A catalogue of miscellaneous books, including a selected list of works on Africa, America, Egypt, India, China and Japan, issued by Messrs. W. Dawson and Son of Cannon House, Pilgrim Street, London, E.C., includes an item of considerable interest to students of the early history of aeronautics. This is a collection of prints, formed by a French collector, relating to the early years of aeronautics, that is, about 1780. Of the eighty items in the collection, about 36 are hand-coloured or partly hand-coloured.

Messrs. Sir Isaac Pitman and Sons, Ltd., have just issued the first part of a second edition of their "Building Educator" (price 1*s.* 3*d.* net). The whole work will be completed in thirty fortnightly parts. It will deal with all aspects of building and should be especially valuable to apprentices, students and craftsmen. It will cover practically all examination work, and at the end a copious index will be provided. A list of the subjects to be dealt with is given in this first number, together with the names of some forty contributors, among whom are Profs. F. C. Lea, H. Adams, C. H. Reilly, and Sir Banister Fletcher, who deals with craftsmanship in building. It is essentially a work which should be in the reading-room of technical schools and colleges.

Applications are invited for the following appointments, on or before the dates mentioned:—An analytical chemist in the Medical Department of the Gold Coast—Director of Recruitment, Colonial Office, 2, Richmond Terrace, Whitehall, S.W.1 (Nov. 15). A University reader in botany at Birkbeck College—The Academic Registrar, University of London, S.W.7 (Nov. 17). An assistant (physics) in the Admiralty Technical Pool—The Secretary of the Admiralty, C.E. Branch (Nov. 18). An assistant lecturer in agriculture and farm book-keeping at the Cheshire School of Agriculture, Reaseheath, Nantwich—The Principal (Nov. 22). A lecturer in chemistry at Rhodes University College, Grahamstown, South Africa—The High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (Nov. 30). An assistant lecturer in agriculture at the Midland Agricultural College, Sutton Bonington, Loughborough—The Principal.

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.*]

Interaction of Hard γ-Rays with Atomic Nuclei

IT is known that when a pencil of hard γ-rays of thorium-C″ passes through lead, in addition to the absorption by electrons of the shell, there exists a type of nuclear absorption, accompanied by the emission of characteristic radiations of frequencies different from the primary[1]. The intensity of such radiations has been estimated, and it has been found that the total energy of the characteristic radiations emitted is much smaller than the total energy of the primary radiation absorbed by the nuclei[2]. This would be expected, if we assume that a nuclear disintegration occurs in such a process, so that a part of the absorbed energy is spent. From this point of view, we have tried to detect electrons which might be ejected from the lead nuclei by the primary γ-quanta.

In our experiment, the γ-ray source was a radium-thorium preparation equivalent to 10 mgm. of radium. Two Geiger-Müller counters, one having an aluminium wall and the other a lead wall, were used. The counters had equal inner dimensions and approximately equal mass per square cm. of the wall (that is, 0·92 mm. thick for the aluminium counter and 0·22 mm. thick for the lead counter). Let N_{Al} and N_{Pb} be the number of electrons produced in equal time intervals by a given beam of γ-rays in the aluminium and lead counters respectively. The ratio N_{Pb}/N_{Al} as a function of the wave-length λ of the incident γ-radiation will at first decrease with decreasing λ, due to the diminishing photoelectric absorption of lead. As the wave-length further decreases, the ratio N_{Pb}/N_{Al} might, however, rise again, if the heavy lead nuclei begin to be disintegrated by γ-quanta of wave-length less than a certain value and the electrons ejected from the lead nuclei in the disintegration process add themselves to N_{Pb}.

By using a beam of γ-rays of thorium-C″ filtered through 2 cm. of lead and scattered by iron at different angles, we measured the ratios N_{Pb}/N_{Al} for γ-rays of different wave-lengths. The experimental result is shown in the accompanying table, where N_{Pb}/N_{Al} is multiplied by a constant k such that the value kN_{Pb}/N_{Al} is unity for the scattered radiation at 23°.

	λ (x.u.)	kN_{Pb}/N_{Al}
Primary radiation	4·7	1·16 ± 0·04
Scattered radiation at 23°	6·6	1·00
Scattered radiation at 46°	12·1	1·23 ± 0·08

In the table, the ratio N_{Pb}/N_{Al} for λ = 6·6 x.u. is seen to be smaller than that for λ = 12·1 x.u., and for λ = 4·7 x.u. it again rises as was expected if electrons were ejected from the lead nuclei by the hard radiation. The difference of the two ratios for λ = 4·7 x.u. and 6·6 x.u. is about 16 per cent. Now, the increase of the ratio N_{Pb}/N_{Al} for λ = 4·7 x.u. might also result from a difference in the scattering effect of the lead nuclei and aluminium nuclei towards the Compton recoil electrons produced in the counter walls by the incident γ-rays. If this were the case, the difference of the ratios for γ = 6·6 x.u. and 4·7 x.u. should be more pronounced by using counters of thicker walls, since the effect of scattering increases with thickness of the wall. But the same result, namely, a difference of about 16 per cent between the two ratios, was obtained when the experiment was repeated with a lead counter with walls 0·3 mm. thick and an aluminium one with walls 1·2 mm. thick. Therefore the above result seems to support the view that the lead nuclei are disintegrated by the hard γ-rays.

The details of the experiment will be published elsewhere.

C. Y. CHAO.
T. T. KUNG.

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Peiping, China.
Sept. 4.

[1] Chao, *Phys. Rev.*, **31**, 1519; 1930. Gray and Tarrant, *Proc. Roy. Soc.*, A, **136**, 662; 1932.
[2] Gray and Tarrant, *loc. cit.* Chao, Science Reports of National Tsing Hua University, 1st series, 1, 159; 1932.

IT is obvious from a letter to me which accompanied the above communication that Prof. Chao and Mr. Kung have not yet heard of the recent work concerning the positive electron, and in particular of the creation of a pair of electrons, a negative and a positive, by the conversion of a γ-ray of high energy in the strong electric field of a nucleus. The experiments they describe provide valuable additional evidence of this phenomenon, and would doubtless have been interpreted by them in this way rather than as a nuclear disintegration. It is interesting to note that the magnitude of the effect is about the same as is found in other experiments.

RUTHERFORD.

'Super-Contraction' and 'Set' in Animal Hairs

IN a recent communication[1] it is shown how the complex elastic behaviour of animal hairs is explicable in terms of a proposed molecular structure the main features of which are deduced from the X-ray photographs. This structure—the keratin 'grid'—consists of a series of 'main-chains' lying parallel to the fibre length, from which protrude, at regular intervals, 'side-chains' which serve to link laterally neighbouring main-chains. In the normal state of the fibre, the main-chains are folded or crumpled, but during extension of the fibre the folds are straightened out, a process producing considerable stresses in the lateral linkages. Under the combined influence of these stresses and the hydrolytic action of water, alkali, etc., breakdown of certain side-chains occurs, leading to the phenomenon of 'relaxation' or loss of tension when the fibre is held stretched. This rupture of cross-links is followed by a re-combination of the broken chains in new unstressed configurations, in consequence of which the fibre exhibits some reluctance to recover its original length when the stretching force is removed; and if the re-building becomes sufficiently pronounced, the fibre may ultimately acquire a 'set' at an extended length. Both breakdown and 'setting' proceed at greater rates as the temperature of the environment increases, and the recovery powers of the fibre after any degree

of relaxation are also greater in steam than in water at lower temperatures. We have called that 'set' which will withstand the contractile action of steam, 'permanent set'; other degrees of 'set' are only 'temporary'. Permanent 'set' can occur after sufficiently prolonged treatment of the stretched fibre in steam or hot enough water.

It is clear that the equilibrium length of the grid under any prescribed conditions is determined largely by the state of its side-chains. Perhaps the most striking illustration of this is afforded by the phenomenon of 'super-contraction', a term which we have introduced to describe the property of hair fibres of contracting, under suitable conditions, to less than their initial lengths. During relaxation in hot water or steam, it is possible to stop the process at a point where considerable breakdown has already taken place, and yet before the subsequent re-building of new linkages has become very pronounced. At this stage the grid is in a condition where the side-chain restrictions are to a certain extent eliminated, and the main-chains are able, under the powerful contractile influence of steam, to fold into shorter lengths than in the normal fibre, so that the fibre shows a super-contraction to less than its original length. As

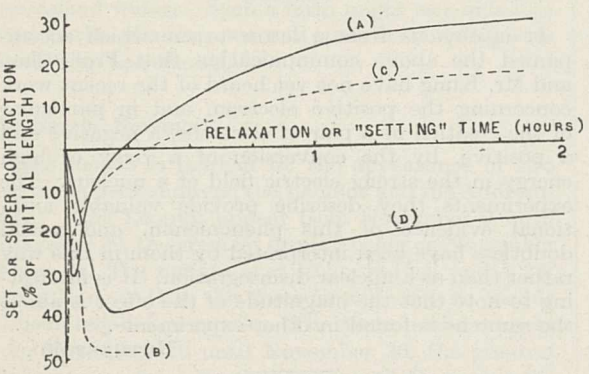

FIG. 1.

the relaxation time increases, a stage is reached when the rate of breakdown just balances the rate of 'setting'; the contraction observed will then be a maximum, and prolongation of the relaxation time will result in a decreased super-contraction on account of the approaching limit of the breakdown and the increasing number of re-formed cross-links. This is shown in the curve (*A*) of Fig. 1, which gives the final extensions of Cotswold wool fibres allowed to contract freely in steam after relaxation at 50 per cent extension in steam for various times.

We have now been able to isolate the two effects of breakdown and 'setting' by allowing relaxation to take place at 50 per cent extension in a dilute (1 per cent) aqueous caustic soda solution. After relaxation, the fibres were allowed to recover their original lengths in the same solution (in order that there should be no extended keratin present which might be 'set' during the subsequent process of contraction in steam), and the alkali was then removed by prolonged washing in water. Curve (*B*) shows how the super-contraction in steam of Cotswold wool fibres relaxed under these conditions depends on the relaxation time; it reaches a limit of 48 per cent of the initial length after about 10 minutes' relaxation. The complementary 'setting' curve (*C*) showing the development of permanent 'set' due to the action of steam, was obtained for fibres which had been relaxed at an extension of 50 per cent for 10 minutes and then allowed to revert to their initial lengths in the alkali, and had then been washed thoroughly before being re-extended and steamed for various times in the stretched state. By this means it is ensured that the action of steam is one of 'setting' from the very first. In the light of these results there seems to be no doubt that the explanation given above of the form of the curve (*A*) is correct.

It is hoped that the study of the modifications of the steam curve (*A*) due to various preliminary treatments of the fibres may throw light on the final details of the phenomenon of permanent 'set'. As an example of such effects, the case of fibres previously soaked in a saturated solution of potassium dichromate may be mentioned. Such fibres give the curve (*D*), and it will be seen that the 'setting' action of steam is very much delayed by this treatment, so much so that even after two hours' steaming in the stretched state, which for untreated fibres would be enough to cause a permanent 'set' of nearly 30 per cent of the initial length, super-contraction of as much as 16 per cent of the initial length can be obtained. Assuming, as seems probable, that the reaction of the dichromate is with the basic $-NH_2$ groups of wool, this result is in good agreement with the observation recently recorded by Speakman[2], that human hair which has been diazotised loses most of its power of acquiring permanent 'set' when acted upon in the stretched state by steam.

H. J. WOODS.

Textile Physics Laboratory,
University, Leeds.
Sept. 22.

[1] W. T. Astbury and H. J. Woods, "The Molecular Structure and Elastic Properties of Hair Keratin" (*Phil. Trans. Roy. Soc.*, in press); see also:—"X-Ray Analysis of Fibres", NATURE, **132**, 593, Oct. 14, 1933. A simplified account of the elastic properties of hair is given in:—W. T. Astbury, "Fundamentals of Fibre Structures", Oxford, 1933.

[2] J. B. Speakman, pp. 95–109, "The Swelling of Proteins" (Conference of the International Society of Leather Trades' Chemists, 1933); *J. Soc. Dyers and Colourists*, **49**, 180; 1933.

Ionisation Density and Critical Frequency

IN a recent letter[1] in these columns, I pointed out that the relation between electron concentration and critical frequency in an ionised gas (Heaviside layer) is

$$N = (\pi m/e^2)f^2 \qquad (1)$$

rather than 3/2 of this. A reference in support of the latter[2] was afterwards brought to my attention. In this article, Prof. D. R. Hartree treated the force on an ion in the gas by the method used by Lorentz for a dielectric, whereas (1) has been derived independently of this type of treatment. It therefore seems advisable to compare the results of the orthodox method when applied, on one hand, to the bound ions of a dielectric, and, on the other, to the free electrons in an ionised gas.

Following the orthodox treatment, the total force acting on an electron (or negative ion) in a dielectric can be considered as the sum of four components: first, that due to charges at a distance, to be designated by eE_0; second, that arising from the charge distribution on the interior of the infinitesimal spherical cavity which is supposed to be scooped out from the dielectric; third, that due to all the dipoles in the scooped-out sphere other than the one of which the electron is a part; and fourth, the attraction of the positive portion of this very dipole.

For a bound electron, the last is not a Coulomb force, but is, rather, an elastic force $-\alpha r$, r being the electron displacement. Writing the components in order, then, the total force is

$$eE_0 + (4\pi/3)eP + 0 - \alpha r. \qquad (2)$$

At first sight it would appear that to make this expression applicable to a free electron, it is only necessary to put $\alpha = 0$. The presence of $(1/3)4\pi eP$ would then lead directly to a coefficient 3/2 in (1).

But such a procedure neglects the Coulomb force of the ion which must replace the elastic binding force. This force can be calculated by supposing the positive ion to be uniformly distributed throughout a sphere of volume $1/N$. The charge density is Ne, so that when the electron is displaced from the centre of this sphere, the restoring force is $-(4\pi/3)Ne^2r$, and it is this which must replace $-\alpha r$. Since $P = Ner$, the total force on the free electron is seen to be

$$eE_0 + (4\pi/3)eP + 0 - (4\pi/3)eP = eE_0. \qquad (3)$$

Thus, when the field of the free positive ion replaces the molecular binding force, the polarisation term disappears as it should, since in fact no polarisation exists. It follows that the coefficient in the corresponding concentration equation is unity.

LEWI TONKS.

Research Laboratory,
General Electric Company,
Schenectady, N.Y.
Oct. 3.

[1] NATURE, **132**, 101, July 15, 1933.
[2] *Proc. Camb. Phil. Soc.*, **27**, 143; 1933.

Stopping Layer of Rectifiers

FROM measurements of the coefficient of rectification as a function of the thickness of the stopping layer, W. Jusé[1] has deduced that rectification is only possible for a thickness of the stopping layer of about 10^{-5}–10^{-6} cm. This is not in agreement with results

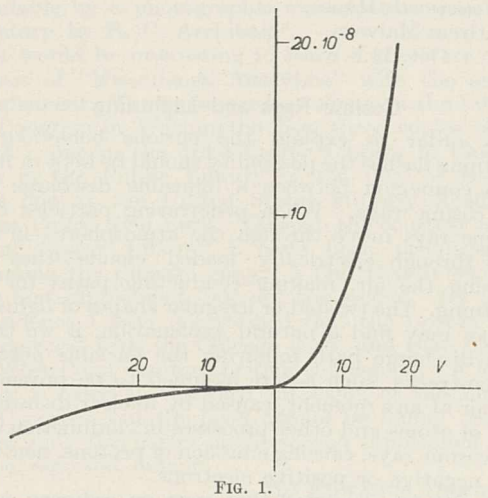

FIG. 1.

I have obtained with rectifiers, the stopping layers of which had thicknesses of 10^{-4}—10^{-3} cm. The mean ratio of the currents in opposite directions varied with different samples and was about 10, sometimes about 100.

The rectifiers were made of a metal and a semiconductor, separated by a stopping layer, which can consist of every insulating material, for example, paper, artificial resin, the oxide of the base metal, etc. It is possible to get rectification with every thickness of the stopping layer between 10^{-6} cm. (oxide-coated aluminium or zirconium) and 10^{-3} cm. (condenser paper).

In Fig. 1 are given the characteristics of a rectifier with a stopping layer of 5×10^{-4} cm. thickness (amorphous Al_2O_3 on aluminium). The ratio of the currents in opposite directions is about 30. In both directions the current can be represented by a function of the form $i = AV^2$.

So far as I can see, these experiments are in agreement with the explanation of the rectifying process by cold emission[2] and do not confirm the Frenkel-Joffé-Nordheim-Wilson theory of the rectifying contact[3].

W. CH. VAN GEEL.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
Oct. 10.

[1] NATURE, **132**, 242, Aug. 12, 1933.
[2] W. Ch. v. Geel, *Z. Phys.*, **69**, 765; 1931.
[3] See R. H. Fowler, *Ph. Z. Sovj. Un.*, **3**, 526; 1933.

Developmental Anomalies in the Wistar Albino Rat (Edinburgh Stock)

IN view of Ornsteen's suggestions[1] offered in explanation of the Laurence-Biedl syndrome, it is of interest to record the occurrence of a group of peculiar developmental anomalies in the albino rat (Wistar derivatives, Edinburgh stock).

In one line of this stock several cases of microphthalmia have been encountered. This eye defect, which has already been reported in the American stock by Addison[2] and Danforth[3], is not infrequently accompanied by opacity of the lens and blindness. In the typical case the eye is very small—roughly a sixth of the normal size—and pale pink; the animals are, in other respects, fully representative of the stock. The distribution of this abnormality indicates that the character is genetic and most probably recessive.

In families related to the above but in which microphthalmia is not present, other peculiarities have been observed. Unilateral cryptorchidism has been found in three males, one of whom is the son of a microphthalmic male; seven females, sisters, possessing rudimentary male external genitalia in varying degrees of development are cousins of the oldest microphthalmic male in the stock. Another cousin has a cloaca instead of a normal rectal opening, together with the deeply cleft clitoris and the rudimentary penis present in the other females mentioned. A brother of the seven females alluded to has a son with a skull deformity which involves the loss of an eye. Within the group, also, there is a number of rats that have experienced difficulty in parturition, death supervening in several instances.

It seems not unreasonable to regard these various abnormal conditions as being instances of the polymorphic expression of one and the same genetic character.

A. M. HAIN.

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King's Buildings,
Edinburgh.

[1] Ornsteen, *Amer. J. Med.*, **183**, 256; 1932.
[2] Addison, *Anat. Rec.*, 20, 344; 1925.
[3] Danforth, *Amer. J. Anat.*, **45**, 275; 1930.

Importation of the Dune Snail into Western Australia

We have recently received from Mr. L. Glauert, Curator of the Public Museum, Perth (W. Australia), a number of shells of the Dune (or Pointed) Snail *Cochlicella acuta* (olim *barbara*). They were obtained by Mr. K. R. Norris in the neighbourhood of Freemantle, where they are abundantly found in gardens and open country and on sand hills. The home of this species is on the Mediterranean coasts and up the west coast of Europe to the British Isles and Denmark, and there is no doubt that its occurrence in Western Australia is due to its having been accidentally transported by human agency. The wide dispersal of certain species of land molluscs (for example, *Subulina octona*) by this means is familiar to many zoologists; but this instance is interesting from more than one point of view.

I have been engaged for some time in the study of the variation and distribution of *C. acuta*. This work is by no means concluded as yet; but it is possible to say this much concerning the distribution. *C. acuta* is primarily an inhabitant of coastal regions and is found typically on sand dunes, dune-pasture and turfy cliff-tops. Here and there, however, it is found inland (for example, in France) and in Ireland it occurs practically all over the country. It is prone to form 'patchy' and short-lived colonies and has some habit or faculty which renders it liable to accidental transport[1]. I was at first inclined to attribute the formation of these colonies (in England at least) to transport by vehicles and certainly in one instance some specimens were taken off the mudguard of a car at Pulborough very many miles from the nearest colony. The position of some of these colonies, however, does not suggest that transport of this kind is universally responsible and it seems more likely that some colonies may be formed by individuals caught up on the coats of cattle or sheep. It occurred to me that *C. acuta* may have been transported in this fashion to Western Australia, as many of the colonies in south-east England are in downland situations of such a nature that individuals are liable to be accidentally picked up by sheep. In response to an inquiry, Mr. Glauert informs me that South Down sheep have been imported from England into Western Australia during the last few years, though it is not yet possible to decide how long the snail has been present in Western Australia and whether its arrival coincided with the importation of South Down sheep. The fact that at Freemantle it is found in gardens may suggest that it may have been imported in garden-produce. For reasons given in the next paragraph this does not seem very likely, though it is not entirely ruled out.

In its new home *C. acuta* is reported to be attacking garden plants and others of economic importance. In no part of its European or North African area, so far as I know, has this been noted. In the British Isles at least it does not seem to occur in gardens unless they happen to comprise part of the natural habitat, for example, dunes or dune pasture. I have, however, taken it myself on the walls of cliff-gardens on the French Riviera (for example, at Rochebonne, near Monaco). If indeed the Freemantle *acuta* was imported from south-east England, the occupation of gardens at Freemantle and the ravaging of garden plants seems to be another instance of the occupation of new habitats and the development of new habits often seen when an animal is introduced into a new area.

P.S. Since writing this letter I have been informed by Mr. R. F. Mills of the Ministry of Agriculture and Fisheries that sheep exported from Great Britain are kept for some time in a quarantine station in London where they are examined daily for scab, etc. It is not likely that snails would be overlooked in the course of such examination, so that the transport of *C. acuta* by sheep does not seem very probable. There remains, however, the possibility that the snail has been carried in the fodder of such exported animals.

G. C. Robson.

British Museum (Natural History),
Cromwell Road,
London, S.W.7.

[1] Cf. Aubertin, Ellis and Robson, *Proc. Zool. Soc.*, London, 1931, p. 1039.

Hot Spring Spiders

Considerable interest attaches to a collection of North American desert Arachnida which have recently been sent to me by Mrs. Florence D. Wood, of New York. The collection, which was made in Powell, Wyoming, and certain localities in Montana, includes the scorpion *Uroctonus mordax*, the phalangid *Mitopus montanus* and the solpugid *Eremobates formicaria*, and a large number of spiders, some of which were captured at the Pipestone Hot Springs, near Whitehall, Montana.

These hot spring spiders are eight adult females and one young specimen of the not uncommon American species *Pardosa sternalis*. All are very brightly pigmented and well developed, and their occurrence, in the words of their captor, "running on water too hot to be borne by the hand", is worthy of record. Spiders on cold water are common enough, but spiders on hot water are something of a rarity.

The finding of the Solpugidæ is also unexpected. They came from western Montana, "which is none too warm in summer". They were not near the hot springs, and this locality seems to be a new record for the genus.

Theodore H. Savory.

Wentworth House,
Great Malvern.
Oct. 11.

Cosmic Rays and Lightning

In order to explain the curious behaviour of lightning flashes the possibility should be kept in mind of a connexion between a lightning discharge and the cosmic rays. When penetrating particles from cosmic rays move through the atmosphere—in this case through electrically 'loaded' clouds—they are ionising the air, making conducting paths for the lightning. The twisted or irregular shapes of lightning flashes may find a natural explanation, if we think of a discharge path following the variable network of ion-tracks, such as are assumed to be present in the air at any moment, caused by nuclear disintegration of atoms and other processes in conjunction with the cosmic rays, causing emission of protons, neutrons and negative or positive electrons.

It may be suggested that even an ordinary spark discharge from a high-voltage apparatus in free air will be of somewhat different appearance, when produced on the surface of the earth and when in a deep mine, where no ionising agent is present.

John Tandberg.

Electrolux Laboratory,
Stockholm, 7. Oct. 13.

De Moivre's "Miscellanea Analytica", and the Origin of the Normal Curve

IN a historical note by Karl Pearson in 1924[1], evidence was presented which shows that Abraham De Moivre (1667–1754) invented the 'normal' curve and the normal probability integral about 1721. The name of Gauss is usually attached to the normal curve, although it is not uncommon to find it more correctly attributed to Laplace. But as Pearson shows, De Moivre ante-dated both Laplace and Gauss in this by many years. "The matter is," Pearson says, "a very singular one historically. De Moivre published in 1730 his *Miscellanea Analytica* . . . Many copies of this work have attached to them a *Supplementum* with separate pagination, ending in a table of 14 figure logarithms of factorials from 10 ! to 900 ! by differences of 10. But only a very few copies have a second supplement, also with separate pagination (pp. 1–7) and dated Nov. 12, 1733." The title of the second supplement is "Approximatio ad Summam Terminorum Binomii $(a + b)^n$ in Seriem expansi", and it contains not only the first use of the normal curve, but also the first use of the approximation for large factorials commonly but improperly known as Stirling's. It is also clear that herein occurred the first correct use of the 'law of large numbers', usually attributed to Jacques Bernoulli (1654–1705) and often called 'Bernoulli's theorem'. Further pertinent comments have also been made by Karl Pearson[2].

The second supplement could be added only to copies of "Miscellanea Analytica" that remained unsold three years after the original issue, and this accounts for its rarity. At the time of writing, Pearson knew of only one copy containing the second supplement—that in University College Library, London—and since then only one more has been discovered ; it is in the Preussische Staatsbibliothek, Berlin. However, the exceedingly rare and important pamphlet of seven pages has been made generally available by a photographic reproduction in a commentary by R. C. Archibald[3].

It would be interesting to learn if there are other copies of "Miscellanea Analytica" with the second supplement. The union card catalogue at the Library of Congress in Washington lists three copies of the book ; one in the John Crerar Library in Chicago, one in the Public Library of the City of Boston, and one at the United States Military Academy, West Point, New York. Through the courtesy of the John Crerar Library I have been privileged to examine the Chicago copy. I find that it contains the first supplement, but not the second. By correspondence I have ascertained that the Boston copy is identical with the Chicago copy, and that the one at West Point contains neither supplement. A fourth copy is listed in the card catalogue at the Library of Congress, but the book cannot be found. So far, then, only two copies of the second supplement have been reported extant.

W. EDWARDS DEMING.

Bureau of Chemistry and Soils,
U.S. Department of Agriculture,
Washington, D.C.
Sept. 30.

[1] *Biometrika*, **16**, 402–404 ; 1924.
[2] *Biometrika*, **17**, 201–210 ; 1925.
[3] *Isis*, **8**, No. 4, 671–683, October 1926.

Effect of Yeast Extract on the Growth of Plants

THE interesting observations of Virtanen and Hausen[1] confirm, in a remarkable manner, our earlier findings of more than a year ago, which have since appeared in a number of publications[2] and have been abstracted in several European and American journals. It is not improbable, however, that the above authors were unacquainted with our earlier work on the subject.

Our observations were first made on the sunflower plant (*Helianthus annuus*, Linn.) and then extended to other species. The plants were raised on soil or sand and treated with organic manures or mineral fertilisers. Aqueous extracts of different biological products were injected directly into the plants so as to avoid the possible effects of the products of their decomposition in the soil. A number of interesting observations were made, but the following illustrate the type of results obtained during two successive seasons :

Plants grown on soil ; treated with farmyard manure.

Fluid injected	Percentage of plants that flowered	Average number of flowers per plant	Average weight of flowers per plant (gm.)
Yeast extract	75·0	4·1	6·9
Water (control)	44·0	1·8	3·7

Plants grown in washed sand ; treated with complete minerals.

Fluid injected	Average dry weight of plant (gm.)	Average dry weight of flowers (gm.)	Percentage weight of flowers to whole plant
Yeast extract	39·24	9·64	24·6
Water (control)	25·21	3·29	13·1

Fairly mature plants responded better to injection of yeast extract than tender ones. Similar, but less marked, effects were observed when extracts of farmyard manure or soil or sewage effluent (activated sludge) were injected into the plants, while extract of dried blood merely increased the total weight of the plant without appreciably affecting the production of flower and seed.

In view of the practical significance of the above findings, the observations have now been extended to a variety of agricultural and horticultural crops. The effect of feeding a number of new substances, both by themselves and in combination with different inorganic salts, has been followed. The nature of the constituents responsible for the effects observed and the mechanism of their action are also being studied. It is hoped that the results of the above and related investigations will be published at an early date.

V. SUBRAHMANYAN.
G. S. SIDDAPPA.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.
Sept. 30.

[1] NATURE, **132**, 408, Sept. 9, 1933.
[2] *Soc. Biol. Chemists* (India), Symposium, July 1932, p. 8 ; *Madras Agric. J.*, **20**, Pt. 11 ; 1932 ; *Proc. Indian Sci. Congress*, **20**, January 1933 ; *Proc. Joint Session S. Indian Sci. Assoc., Soc. Biol. Chemists* (India), and *Indian Chemical Society*, April 1933, p. 11 ; Appendix to *Ann. Rept. Indian Inst. Science*, 1932 ; *ibid.*, 1933.

Euchlorine

In textbooks and dictionaries of chemistry the statement is continually made that Davy supposed the product of the action of hydrochloric acid on potassium chlorate to be a definite compound to which he gave the name euchlorine.

A careful reading of Davy's own words shows he knew quite well that the product was a mixture of chlorine and an oxide of chlorine and that he proposed the name euchlorine for the latter ingredient of the mixture. The following quotations from Davy's paper in the *Philosophical Transactions* for 1811, vol. 101, pp. 155–162, "On a Combination of Oxymuriatic Gas and Oxygene Gas", and reprinted in No. 9 of the Alembic Club Reprints, make the matter quite clear. (Pages given are from Alembic Club Reprint.)

P. 64. "The gas produced by the action of muriatic acid on the salts which have been called hyperoxymuriates, on the contrary, differs very much in its properties, according as the manner in which it is prepared and collected is different. . . . It is a compound of oxymuriatic gas and oxygene, mixed with some oxymuriatic gas." This last sentence put in modern terms reads: "It is a compound of chlorine gas and oxygen mixed with some chlorine gas."

P. 65. "I attempted to obtain the explosive gas in a pure form, by applying heat to a solution of it in water; but in this case, there was a partial decomposition; and some oxygene was disengaged, and some oxymuriatic gas formed."

P. 67. "That the explosive compound has not been collected before, is owing to the circumstance of water having been used for receiving the products from hyperoxymuriate of potash, and unless the water is highly saturated with the explosive gas, nothing but oxymuriatic gas is obtained." That "the explosive gas" and "the explosive compound" refer to the "compound of oxymuriatic gas and oxygene" in his mixture is clear from the contexts.

Finally, p. 70. "As the new compound in its purest form is possessed of a bright yellow green colour, it may be expedient to designate it by a name expressive of this circumstance, and its relation to oxymuriatic gas. As I have named that elastic fluid Chlorine, so I venture to propose for this substance the name Euchlorine, or Euchloric gas from ευ and χλωρος."

Evidently Davy knew he was dealing with a mixture and had a certain degree of success in separating the ingredients.

W. Lefèvre.

9, Oak Park Close,
Shiphay, Torquay.
Oct. 2.

There is no reason to suppose that Davy ever separated the chlorine from the chlorine dioxide in euchlorine, or that he deliberately gave the latter name to pure chlorine dioxide. In his "Elements of Chemical Philosophy" (1812, p. 239) he says: "Chlorine is rapidly absorbed by mercury; euchlorine has no action upon it, and chlorine may be separated from euchlorine, by agitation over mercury, and the last obtained pure." This is incorrect, since chlorine dioxide attacks mercury (King and Partington, *J. Chem. Soc.*, 925; 1926). There can be no doubt whatever that Davy's euchlorine was, as it is always correctly stated in textbooks to have been, a mixture of chlorine and chlorine dioxide, since (*op. cit.*, 240) he found that on decomposition by heat it gave 2 vols. of chlorine and 1 vol. of oxygen: "50 parts treated in this way, expand so as to become about 60 parts, which consist of 40 parts of chlorine and 20 parts of oxygene." The separation of pure chlorine dioxide from the mixture, by passing it over calomel, and the first proof that euchlorine is a mixture of chlorine dioxide and chlorine are due to Soubeiran (*Ann. Chim. Phys.*, **48**, 116; 1831; mentioned by Turner, "Elements of Chemistry", 1834, p. 341, who says "most chemists regarded the existence of euchlorine as problematical, suspecting it to be a mixture of chlorine with the peroxide of chlorine"). Soubeiran's work seems to have been overlooked. Pebal finally decided the matter, if that were necessary; his memoir (*Liebigs Annalen*, 177, 1; 1875) is a model of experimental research.

J. R. Partington.

81 Barn Hill,
Wembley.

Frederick Guthrie

I was glad to see the reference to the late Prof. Guthrie in Nature of October 14, p. 595. I had the good fortune to know him from 1870 onwards. In my recent Huxley Memorial Lecture (Macmillan and Co., Ltd.), I specially refer to him, in an aside (p. 9), to the way in which he taught real earthly physics, now a lost art, since the retirement of the last of the Mohicans, Prof. A. W. Porter. The student of to-day can only lisp electrons and other letons: heat, optics, sound, even battery-electricity, are no more! Physics is becoming all skittles, without any beer: the game is even puffed by wireless, for general consumption. We need to recover physical sense of proportion. I have, therefore, asked whether someone cannot be found to unearth Guthrie's incomparable practical course—if only to put it away in a case, in the British Museum, as the memorial of a former Brompton civilisation of high degree. Let the course be published, fully explained, together with a proper appreciation of the man and the poet. We have to remember that he was not only all but the last physicist—certainly the last with sense of humour—but also the last physical chemist: both chemist and physicist.

I have asked in my lecture:

"Why is it that, while remembering Huxley, the Imperial College has forgotten the great pioneers of practice, on their early staff, his companions Frankland, Tyndall, Guthrie?"

Huxley has been overrated relatively to these three men. The great scientific service his three colleagues rendered has been allowed to fall into oblivion; it were time to roll their logs too. Let us begin with Guthrie. Someone must have full notes of his course.

Henry E. Armstrong.

55 Granville Park,
Lewisham, S.E.13.

New Band Systems in the Gadolinium Oxide Spectrum

I am sorry that in my letter under this title published in Nature of September 23, p. 481, I included two formulæ not concerned with these spectra. The correct formulæ are:

$$\nu = 21700{\cdot}26 + 749{\cdot}20(n' + \tfrac{1}{2}) - 3{\cdot}30(n' + \tfrac{1}{2})^2 - 830{\cdot}00(n'' + \tfrac{1}{2}) + 2{\cdot}25(n'' + \tfrac{1}{2})^2.$$

$$\nu = 20470{\cdot}29 + 771{\cdot}30(n' + \tfrac{1}{2}) - 5{\cdot}45(n' + \tfrac{1}{2})^2 - 841{\cdot}00(n'' + \tfrac{1}{2}) + 3{\cdot}70(n'' + \tfrac{1}{2})^2.$$

Giorgio Piccardi.

R. Università,
Firenze.
Oct. 10.

Research Items

Mayan Roads. The Carnegie Institution of Washington in its *News Service Bulletin*, vol. 3, No. 9, reports on the results of an expedition recently sent out in charge of Señor Alfonso Villa by Dr. Sylvanus P. Morley, with the object of examining one of the Mayan roads which run from Coba, a Mayan city in Yucatan of consequence in pre-Columbian days. The city is a centre of raised constructed roads running in all directions to the various groups of ruins situated about the chain of freshwater lakes of the district. The road which was to be examined runs westward, and, it was thought, terminated at Yaxuna, about twelve miles south-west of Chichen Itzá; but it had never been traversed or surveyed, owing to the density of the forest growth. The expedition started at Yaxuna and reached Coba three weeks later, after traversing sixty-two and a half miles. About two miles from Yaxuna the expedition found a stone cylinder, 13 ft. long and 2½ ft. in diameter, weighing about five tons, which may have been used as a roller in the construction of these roads of paved stone. It was found on one side at the top of the causeway, as if left there when work was completed. The road starts at the Yaxuna end from a small pyramid and runs almost perfectly straight for forty-three miles. For the remaining distance it changes its original direction only four times and then but slightly. In width it varies from thirty to thirty-four feet, in height above the terrain from two to eight feet. There was evidence which appeared to point to the road having once connected various settlements. At several points were small platforms from thirteen to sixteen feet in height. They are of unknown purpose, but may have served as wayside shrines. It also appeared that walls had once been built squarely across the road, as if to bar it against enemies. Near Coba a series of six stones inscribed with Mayan hieroglyphs were found, scattered at fairly regular intervals over a distance of seven miles. These may record the completion of various sections of the road.

Handwriting as a Psychological Test. The international quarterly *Character and Personality*, 1, No. 2, contains an article by A. A. Roback on "Writing Slips and Personality". Nine subjects were induced to write dictated words and symbols as rapidly as possible, until the increasing speed of dictation made it impossible for them to keep pace with it. The subjects were told beforehand what the stimuli units would be, so as to preclude the possibility of mishearing and to limit the interference to the motor side. Under such conditions, every subject made numerous slips which were mainly determined by the course of least exertion: this comprises two complementary processes, perseveration and assimilation. Under the latter heading are classed superfluous movements, mechanically induced and resulting from over-compensation. It was also found that vowels were more commonly omitted or slurred than consonants, and of these the less pronounced ones, such as *l*, *c*, or *t*, were dropped. The same subject tended to break down at the same place in the series several times. Interference, on the whole, brought out the characteristic of the handwriting in an exaggerated form. Individual differences in attitude and methods in response to the test situation were pronounced and instructive. Comparison of results obtained from border-line psychotic patients indicated the possibility of the test having considerable diagnostic value. The article concludes with a discussion of the rôle of the unconscious in writing lapses and a severe criticism of the Freudian interpretation. Mr. Roback argues in the light of his own results that the Freudians have to invoke two entirely different principles to explain identical phenomena, according as they are procured experimentally, or occur under natural conditions.

Habits of Green Turtle. The report of the Great Barrier Reef Committee just issued (vol. 4, pt. 1. Brisbane: Government Printer) deals with turtle, *Trochus* and sponges, which are being investigated by F. W. Moorhouse. Green or edible turtle, both adults and young, were marked, and the latter reared under observation in their early stages. Copulation takes place floating on the surface of the sea. The females commence to come ashore at the end of October, and as many as seven layings of eggs at fortnightly intervals have been recorded per animal from the same beach. The females first mature with a carapace length of about 35 in. and were caught up to 48 in. The average number of eggs at a laying is 120, and of these 55 per cent hatch in about ten weeks. The young break from their nests at nightfall, so avoiding the herons and gulls, but many fall a prey to large crabs (Ocypoda) in their passage to the sea, where sharks and large fish await them, so that the loss is extraordinarily high. The young have unabsorbed food yolk on hatching, but soon commence to feed in the observation pools on fish, clam and meat. Abnormalities in the number of horny plates on the back were supposed to be very rare in the green as compared with the loggerhead turtle. While some families showed no variations, others had up to 33 per cent, but the variations figured do not suggest that these have any phylogenetic significance. A close season in October and November is recommended, so as to ensure the laying of the early clutches of eggs.

Innervation of Skin of Frog. Mlle. J. Ackerman (*Bull. Internat. Acad. Polon. Sci. et Lettres*, No. 7, Bd. 2, 1932) states that the skin of the frog, *Rana esculenta*, is innervated by a nerve-net which consists of two plexuses, a subepidermal and a subcutaneous, intimately connected by nerve bundles. The skin of the dorsal surface of the head and body and of the extremities is much more richly innervated than the ventral surface of these parts. The difference is shown in the more frequent presence in the epidermis of special nerve endings and of Merkel's sense-organs, as well as in the specific disposition of the subcutaneous nerve net. This network exhibits special condensation in the elevations of the granule glands and especially in the gland swellings. The subcutaneous plexus is formed by splitting or confluence of nerve fibres in the knots of the net. Isolated nerve fibres, known from the observations of previous workers, are present in the cutis; they divide and terminate in special clusters or in contact with the peripheral ganglia or they innervate the epidermis. A new type of free nerve ending in the epidermis is described.

Inheritance of Disease Resistance in Mice. In 1917, Dr. E. E. Tyzzer described an epidemic in his mouse colony, due to an organism which he described and named *Bacillus piliformis*. Japanese waltzers, regarded as derived from the Oriental *Mus bactrianus*, were highly susceptible, the bacteria infecting especially the liver, while common mice (*M. musculus*) were relatively immune. Messrs. Gowen and Schott (*J. Hygiene*, Vol. 33, No. 3) have recently made a study of the inheritance of this immunity in crosses between the two species and their inbred or back-crossed offspring. They confirm Tyzzer in finding that resistance to this disease is dominant to susceptibility, and they point out that this relationship of resistance being dominant appears to be general (with one exception) in the case of diseases produced by pathogenic organisms in both plants and animals, where the inheritance of susceptibility has hitherto been studied. The authors find that susceptibility to *B. piliformis* segregates, in crosses between Japanese waltzing and common mice, independently of the waltzing factor, the dominant white factor, and sex. They interpret the resistance as depending on a major dominant factor, the expression of which is affected by modifiers in certain crosses.

Virus Complexes of the Potato. The virus disease of potatoes known as 'crinkle' causes a great deal of damage. It has been studied extensively, but its symptoms were erratic and rarely constant upon one host. Recent work by several investigators has shown that the disease is caused by a mixture of viruses, and a paper from the Albert Agricultural College, Glasnevin, I.F.S., by Miss P. Clinch and Mr. J. B. Loughnane contributes to our knowledge of the constituent viruses ("A Study of the Crinkle Disease of Potatoes and of its Constituent or Associated Viruses". *Sci. Proc. Roy. Dub. Soc.*, 20, No. 40, pp. 567–596. Sept., 1933). A crinkle disease, identical with that occurring under natural conditions, can be produced if a potato plant is infected with 'simple mosaic' and with virus 'A'. The reactions of these constituent viruses of crinkle and also of interveinal mosaic and Up-to-Date streak upon different hosts are described and their methods of transmission are discussed. The 'A' virus is similar to the 'Y' virus described by Dr. K. M. Smith of Cambridge, though distinct from it, and simple mosaic is similar in type to the 'X' virus of the same investigator. Workers on virus diseases will be gratified by the general agreement of the Irish workers with the Cambridge school, and the paper under review also elucidates the relations of some of the viruses to necrotic diseases.

A Disease of Larch Seedlings. The Forestry Commission has issued as leaflet No. 21 a clear account of the diagnostic features that permit the recognition of a disease, which although very prevalent on the leaves of seedlings of European larch in the nursery, does not appear to attack Japanese larch. The fungus *Meria laricis* can be recognised on the withering leaves by staining up its spore clusters with cotton blue, when they show up as rows of dark blue spots, usually on the upper surface of the leaf, because the spores occur in the stomata, which are arranged in parallel rows along the leaf needles. To control the disease in the nursery the spraying of the seedlings with sulphur as early as the end of February is recommended.

Scattering of Atom Beams by Atoms. Frazer and Broadway have recently discussed the application of the 'Hamburg' molecular beam technique to the scattering of one stream of molecules by another (*Proc. Roy. Soc.*, A, September). For simplicity of technique and interpretation, a beam of alkali atoms (sodium or potassium) was scattered by atoms of the vapour of *trans*-$C_2H_2I_2$. These atoms are heavy and slow-moving compared with the alkali atoms, and the scattering is therefore nearly symmetrical about the direction of the primary beam. After passing through the stream of $C_2H_2I_2$ molecules effusing molecularly from an oven, the alkali atoms were caught on an annular ring of heated tungsten coaxial with the main beam. The position of the ring could be varied to change the angle of scattering used. The temperature of the oven containing the alkali metal was kept constant, and the molecular beam was therefore constant in strength. The number of alkali atoms striking the ring was measured by observing the current due to their ionisation at the tungsten surface. The angular distribution curves show a monotonic decrease of scattering with angle and can be explained roughly on the basis that the atoms or molecules behave as rigid spheres. In a second paper, Broadway measures the decay (due to scattering by the mercury atoms) of alkali metal beams in mercury vapour. This is related to a quantity Q analogous in the quantum theory to the collision cross-sections. The experimental curves fit well with the quantum theory of Massey and Mohr. Values of the 'collision radii' for Na, Hg of 11·1 A. and for K, Hg of 12·2 A. are larger than those obtained from classical kinetic theory data, and this is in line with quantum theory predictions. It is hoped that the method of crossed molecular beams used in these experiments may be used in cases where there are strong attraction forces between the molecules and that it will then throw light on the primary processes of chemical reaction.

Motion of the Moon. Prof. E. W. Brown has published an analysis of the observations of the motion of the moon in the years 1923–31 (*Mon. Not. Roy. Ast. Soc.*, June). The author discusses the mean results of all the observations of occultation reduced by the British Astronomical Association and American Association of Variable Star Observers, as well as all the meridian observations made at Greenwich and Washington during the years concerned. The discussion is, of course, concerned with the question as to whether the small systematic deviations from the moon's tabular position which appear are real, or arise from systematic errors. There is a well-marked oscillation in the moon's longitude which has a period close to the year and a half amplitude of about three tenths of a second of arc, and there is also an oscillation in the latitude, which has a fourteen-month period. The occultations give an amplitude of 0·3″ for the latter motion, and the meridian observations give 0·2″. If we attribute deviations of the observed lunar motion from gravitational theory to variation in the rate of rotation of the earth, the rotation has been nearly constant in the years 1923–1931. The probable error in the annual rate does not appear to be greater than $0{\cdot}2^s$, so that the practical second of time as deduced from the earth's motion must approximate extremely closely—to within one part in one hundred million—to the theoretical unit of time in gravitational astronomy.

The National Central Library

By DR. S. C. BRADFORD

THE new building of the National Central Library, Malet Place, W.C.1, which H.M. the King, accompanied by H.M. the Queen, has consented to open on November 7, crowns the generosity of the Carnegie United Kingdom Trustees, and marks the last main stage in the development of an organised system of library co-operation in Great Britain, which has been evolved during many years.

The need for a supply of books for the use of the general population is a comparatively modern development of civilisation. It is the outcome of a national system of education. The industrial revolution brought to ever-widening circles of the population the realisation of the need for knowledge, and education became a prime necessity of national life. Education implies books; and the need for books accessible to all classes led to the movement for the establishment of public libraries. The War emphasised the lesson that study and research are essential, not merely for progress, but also for survival in the struggle for existence, and now few would deny that, if Great Britain is to continue to hold its own, it can be only by the application of all the resources of knowledge and intellectual culture.

The public libraries movement in Britain may be said to date from the Select Committee of 1849, which was appointed by the House of Commons to report "on the best means of extending the establishment of Libraries freely open to the Public especially in large towns in Great Britain and Ireland". The report refers to the disadvantages under which intellectual progress laboured owing to the absence of public libraries. "The great practical education of an Englishman is derived from incessant intercourse between man and man and from the interchange and collision of opinion, both teaching him that most important of all lessons, the habit of self-control. But it would be wise to superadd to these rugged lessons of practical life some of the more softening and expanding influences which reading and thought supply." The establishment of mechanics' institutes and the foundation of lectures for adult education led naturally to a demand for books for reading. The power of access to standard works in a public library would tend to render the lecturer less superficial and to promote investigation among his hearers. Rural districts were not forgotten. "Much of the future character of our agricultural population, social, moral and religious, may depend on the extension and due formation of Village Libraries." The ½*d.* rate provided by the first Bill was increased to 1*d.* by the Public Libraries Act of 1855, which limitation was not removed until the Public Libraries Act of 1919.

From 1892 onwards very rapid progress in the development of the public libraries system of Great Britain took place through the munificence of Mr. Andrew Carnegie, and afterwards of his trustees. Besides the provision of the capital necessary for the building of hundreds of libraries, the funds vested in the Carnegie United Kingdom Trust, now representing nearly three million pounds, were applied to the extension of the County Library movement. The basis of this system is the formation of a central collection of books, the distribution of a selection of books to centres throughout the area, and the loan of these books through the medium of local libraries.

For the co-ordination of the whole scheme of library service a central library was needed. With thirty-two million books in existence, no library can contain all that may be needed by students. The National Central Library arose from an experiment commenced in 1914. In that year the Workers' Education Association, in conjunction with Toynbee Hall, established a library for the purpose of supplying books to Workers' Educational Association classes. Recognising the importance of the work of this small library in making available the books required for study by working students, the Carnegie United Kingdom Trustees made in 1916 a grant of £600 to assist in the establishment of a "Central Library for Students", £2,000 for additions to the stock of books and £400 per annum. Afterwards these grants were greatly augmented. While continuing to serve individual students, the Library began more and more to lend through public and other libraries, so that every serious reader might obtain standard books that he could not obtain from his local resources.

The usefulness of the Library was further increased by the development of a system of 'outlier libraries', which received grants from the Trust on condition that the books and periodicals in these libraries were made available to the public through the Central Library. By 1932, 128 libraries had become so associated. The inquiry office established by university libraries through the Joint Standing Committee on Library Co-operation for inter-university loans was transferred to the National Central Library in 1931.

Another notable service rendered by the National Central Library is an arrangement whereby books, not obtainable in any other way, may be borrowed from or lent to foreign libraries. During 1932, 151 books were lent to 29 foreign libraries, while 52 books were obtained from abroad for 17 libraries in Great Britain. Although the number of books obtained in this way is not great, the service removes a difficulty which has long been irksome. Thus the function of the Central Library became to supplement the supplies of books which public libraries can provide for students and to co-ordinate the various existing agencies, so as to put the individual student, wherever he lives and whatever the subject of his study, into touch with the particular library, general or specialised, which has the books of which he is in need.

As the result of the Report of the Public Libraries Committee of the Board of Education, which was presented to Parliament in 1927, the Central Library for Students was granted a Royal Charter under the title of "The National Central Library" and given a Government grant of £3,000 supplementary to the generous contributions already being received from other sources. In the new building, provision has been made for housing one million volumes.

In this way a library service has now been established whereby a student, living beyond the range of the reading rooms of the great libraries in London and requiring a rare or expensive book for the purposes of research, may apply in the usual way to his public library. If the public library does not possess the book and does not consider it reasonable

to buy it, application is made by the librarian to one of the regional libraries to be established for the co-ordination of public libraries within definite areas. If the regional library cannot supply the book, the application is sent to the National Central Library. The National Central Library applies to the institution likely to possess the book, borrows it on behalf of the student and accepts responsibility for its return. Or, if the book cannot be traced in any library, the National Central Library will purchase the book and lend it to the public library for the use of the student.

A considerable proportion of the books for which applications are made under this scheme are scientific, particularly scientific periodicals. The Science Library in the Science Museum at South Kensington is being developed as a central library to provide for the needs of scientific workers, whose claims have been emphasised on a number of occasions. It is hoped that in time all scientific periodicals which are of substantial importance will be available. By an arrangement which came into force in 1926, books and periodicals are lent to research workers through the medium of approved institutions or organisations where scientific or technical work is carried on. Books are also lent to universities, scientific societies and Government institutions. A very extensive collection of bibliographies comprising forty million references is maintained, periodical literature is indexed and bibliographies are supplied on request.

It was therefore arranged that the Science Library should be the principal source on which the National Central Library should depend for the loan of books needed by students in science. In order that the Science Library might be made as complete as possible, it was recommended in 1927 that its purchase grant should be increased by £3,500, of which an annual increment of £1,500 has been received. Applications from public libraries for research books in science are forwarded through the Central Library to the Science Library, whence the books are despatched to the library making the application.

It is clear that the work of the National Central Library will be greatly facilitated when it is in possession of a catalogue of all libraries associated with it, whether regional libraries, university libraries or special libraries. Were the catalogues of these libraries available in printed form and prepared in accordance with a uniform system, the problem would be of easy solution. It is extraordinary that no standard system of cataloguing has yet been agreed upon, and that each library undertakes the routine cataloguing of all the books it receives, when a single catalogue title for each book prepared in a central library would eliminate all this unnecessary work. On account of the diversity of system adopted, the formation of a union catalogue of all libraries associated with the National Central Library becomes a matter demanding much time and energy. The work is, however, making satisfactory progress, and its completion will do much to simplify the work of the National Central Library.

Physics in the Building Industry

THE twentieth lecture in the "Physics in Industry" series of the Institute of Physics was delivered by Dr. R. E. Stradling, director of the Building Research Station, before the Manchester and District local section of the Institute of Physics on October 27 and again in London on November 1.

Referring to attempts which have been made to give a logical basis to traditional knowledge or craftsmanship as it appears particularly in the building industry, Dr. Stradling instanced the case of classifying building materials. Three groups have been suggested: crystalline aggregations, amorphous materials, and quasi-solids or gels. After a brief description of the first two groups, Dr. Stradling gave a rather more detailed discussion of the third group. He pointed out its importance in building work and gave a general discussion of the physical properties to be expected. Special emphasis is laid upon the volume changes due to variations in moisture content and the associated changes in physical properties; and the phenomenon of 'creep' seems to be a general characteristic of the group.

Dr. Stradling discussed the plasterers' craft, indicating how the original traditional art has been made impossible in practice by the conditions of modern times. The basis of the craft was work in lime as a medium, and local traditions with local limes were the original conditions. Modern transport facilities both for men and materials have changed all this, bringing about almost hopeless confusion to the craftsman. In addition, the time allowed for the completion of a building is now much shorter than that required for traditional construction. This in itself almost prevents the use of certain limes which do not develop, at a sufficiently early date, even the little strength required for this type of work. Thus 'new' plastering materials have been introduced, sometimes of the 'patent medicine' variety, and as the craftsman tries to use these by his usual craft methods, there should be little surprise that failures occur.

Hydraulic cements form a section of industry of comparatively modern growth. Their development at first was purely empirical, by trial and error on a large scale. Even now little is known of the chemistry of the subject. Owing to commercial competition, certain special lines of development have taken place since the War and this has necessitated an intensive study of moisture relations and creep phenomena. This work seems to indicate that a too one-sided development has occurred and that for general practice a return to earlier products may be desirable. Dr. Stradling offered an explanation of the interaction of 'creep' and shrinkage due to moisture change and outlined the problem of the effects of heat generations during the chemical processes of setting.

Steel structures are of interest in that they represent an industry, comparatively modern, which has taken the step of inaugurating research into its practice in order that no chance should be missed of bringing about true economy in construction. Mathematical problems of considerable complexity are involved and the effort is being made to present such work in the form of 'working rules'. Measurements of the actual strains in existing buildings are carried out, and although the work is still in hand, there seems every hope of it resulting in placing this section of the building industry upon a higher plane of scientific and practical development than almost any other.

The present state of an industry possessing a long

tradition such as building is one of transition of quite a different order from anything it has experienced before. Nearly the whole basis of its traditional knowledge has ceased to exist or has so changed as to be scarcely recognisable. Only by intensive co-operation between practitioner and scientific worker can the necessary readjustments be made, for it is not possible to await the wasteful type of development resulting from 'trial and error' on a full scale.

Dr. Stradling concluded by saying: "What is true of building is probably true of many other industries. The problem of national readjustment is urgent and instead of making an attempt to hold up scientific research on the excuse that science has proceeded too fast and too far, the opposite is really the absolute necessity of existence. The 'clock cannot be put back' and we have had scientific work with us sufficiently long to have produced a transitional period of appalling intensity and thus the only way is forward."

Copies of the "Physics in Industry" lectures can be obtained from the Institute of Physics, 1, Lowther Gardens, Exhibition Road, London, S.W.7.

Megalithic Work in Assam

DR. J. H. HUTTON, in discussing megalithic work in Assam, in a paper read on September 11 before Section H (Anthropology) at the Leicester meeting of the British Association, stated that it is important not only as bearing on the cultural and racial relations between Assam and the adjoining regions, but also on the whole question of Indian pre-history and cultural and racial relations with the Mediterranean and with Oceania. Megalithic work in Assam, and probably throughout India, has definite associations with the dead and with their post-mortem future. At the same time it is, at any rate in Assam, definitely phallic in certain aspects and constitutes a fertility cult of the dead.

The idea of life as a finite material substance, limited in quantity, and passing, when the body dies, into the crops as a fertilising agent and thence in a recurrent cycle to beasts and men, is common in Assam. This conception led to the practice of providing receptacles for the life substance after the death of the body, in the shape of wooden or stone statues, generally, though not always, in the form of rough stone monuments, sometimes phallic in shape.

The Dinapur monoliths are similar in design to the wooden emblems used at a fertility ceremony by the Angami Nagas, who, however, use simple *menhirs* differing merely in size to represent the two sexes, or to house their life matter. The prehistoric mortuary urns of the North Cachar Hills sites are in some cases definitely male or female in form, suggesting the stone cists still used by the Konyak Nagas, which take the form of the sex of the individual whose skull is found within, the life matter being accommodated immediately after death in a wooden statue pending the removal of the head from the corpse when putrefaction is fairly advanced.

Many similar customs were reported, and the theory was advanced by Dr. Hutton that they are associated with a conception of life as a material and finite substance, a theory logically leading to head hunting, cannibalism and human sacrifice as means of obtaining life matter. The first conception of life is likely to have arisen from an attempt to understand death and the obvious, but by no means easily explicable, difference between a living man and a corpse. Life would naturally be regarded as a concrete and finite substance by savages to whom abstractions are foreign, and hence follows a wide field of speculation. On one hand, it has led to human sacrifice and similar means of obtaining life matter; on the other, to the Vedantic philosophy, which regards the body as a mere shell to house the soul, and only one of many such shells. It may be that this philosophy of life originated in the pre-Aryan civilisation of India, which was probably of Mediterranean or Syrian origin.

Synthetic Œstrogenic Compounds

SPEAKING at a discussion on hormones at a meeting of Section B (Chemistry) of the British Association on September 8, Prof. F. Kögl foreshadowed the importance of a paper to be read by a subsequent speaker on the significance of synthetic œstrogenic compounds. Prof. Kögl was referring to the oat shoot bending test for auxin. He stated that until comparatively recently this test was regarded as specific for this compound; but he now felt less positive concerning this in view of the picking of the œstrus lock with a skeleton key.

The fact that the complicated œstrus reaction, with its vaginal and uterine phases, can be induced by so relatively simple a compound as 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene was first demonstrated by Cook, Dodds and Hewett[1]. It was later shown in conjunction with Greenwood of Edinburgh, that this compound is capable of causing the feathers of the capon to revert from male to female. By this test they would appear to have demonstrated that the lock had been really opened, and not merely forced. Furthermore, a series of other compounds was added to the list.

Another very active compound is the 9 : 10-dihydroxy - 9 : 10 - di - *n* - butyl - 9 : 10 - dihydro - 1 : 2 : 5 : 6-dibenzanthracene. This was found to be many times more active than the keto-phenanthrene derivative, and to have an activity approaching that of the naturally occurring hormones. The similarity of the molecule of this compound to that of certain of the carcinogenic hydrocarbons led to the investigation of these substances from the point of view of œstrus production. It was found that two of these carcinogenic hydrocarbons, namely, 1 : 2-benzpyrene and 5 : 6-cyclopenteno-1 : 2-benzanthracene, possess the power not only of inducing carcinoma, but also of inducing œstrus. As pointed out by Cook and Dodds[2], there is no evidence that carcinogenic compounds can arise from œstrin in the body.

Another observation difficult of interpretation was made when it was shown that calciferol, ergosterol

and neoergosterol are all capable of producing œstrus when injected in sufficient quantity[3].

In the first place, these observations focused the attention of chemists and biochemists upon a group of compounds the activity of which from a pharmacological point of view was more or less completely unrecognised until the present time. Admittedly the phenanthrene nucleus was known to form an essential part of certain powerful alkaloids, but it was never suspected that a hormone would be found with a similar structure. It would appear almost justifiable to conclude from the observations quoted above that sterol metabolism has a very much wider and more important bearing than has hitherto been suspected, and that it may be possible to establish a connexion between carcinogenesis, certain phenomena of sex, and vitamin D activity. The dual activity of some of these condensed carbon ring molecules reported by Cook and Dodds[4] may possibly mean that this group of compounds forms the link between these three processes.

In any event, the observations undermine the whole conception of the specificity of the hormones, and one is tempted to speculate that, if so complicated a lock as that of œstrus can be picked by a number of skeleton keys which differ so much in appearance from the original key, then would it not be possible to find synthetic keys for other hormone processes? What is certainly very alarming is the thought that two pharmacological neighbours' doors may be opened with the same key, namely, the œstrus and the vitamin D doors, or, to take the case of a more unpleasant neighbour, the carcinogenic and the œstrus door.

[1] NATURE, 131, 56; 1933.
[2] NATURE, 131, 205; 1933.
[3] *J. Soc. Chem. Ind.*, 52, 268; 1933.
[4] NATURE, 131, 205; 1933.

Meteor Shower of October 9

By A. KING

THE meteoric display of October 9 last completely surpassed expectations. In the south of England the sky was overcast, but the shower was seen in other parts of the British Isles. Mr. R. R. S. Cox, at Sheffield, observed "a considerable shower of meteors mostly in Draco and Cygnus". At Eskdalemuir Observatory, Dumfriesshire, Mr. L. Dods saw "literally thousands of meteors" between 19.45 and 20.30 G.M.T. They were most numerous in the first half of this period. Mr. W. B. Housman, at Seaton, Cumberland, watched the declining stages of the display, the sky being cloudy until 9.45 p.m. In Ireland, Mr. W. H. Milligan observed from 7.30 to 8.30 p.m. at a spot near Omagh: "I saw them literally in thousands. . . . At one time as many as 100 might have been seen in any 5 seconds of time." He placed the maximum between 7.45 and 8.00 p.m. At Armagh the Rev. W. F. A. Ellison considered that, near 8 o'clock, the meteors fell as thickly as the flakes of a snowstorm, and he timed the maximum as between 8 and 8.20 p.m.

On the Continent the shower was seen across the whole of Europe. In Portugal the peasants took refuge in churches, believing that the heavens were falling. At Birchircara, Malta, the display was carefully noted by Mr. R. Forbes-Bentley, who took counts over five-minute runs between 6.30 p.m. and midnight. He estimated that about 22,500 meteors were observed, only four of which did not belong to the great shower. There were no meteors in the last hour. He placed the maximum at about 8.15 p.m., when the rate was about 480 per minute. Miss N. Sytinskaja, Leningrad, states that at 18h. U.T., meteors were so frequent as to attract the attention of casual observers. The maximum was at about 20h.; the rate reached 100 a minute at Leningrad, 300 a minute at Pulkovo and 200 a minute at Odessa. The display then gradually weakened, and ceased at 22h. Meteors of mag. 2–3 prevailed; most of them left trains, colour yellowish.

The observations may be summarised as follows:—

1. The shower was probably richest in Ireland.

2. The meteors were generally faint. In Malta, for example, only about 5 per cent reached first magnitude; Mr. Milligan says they were mostly 4th mag. or less.

3. The maximum of the display took place at about 8 p.m., or shortly afterwards, varying slightly with different observers.

4. The effective duration of the 'storm' was 4 to 4½ hours, from which it appears that the thickness of the stream at the part traversed by the earth was roughly 300,000 miles.

5. *Determinations of the Radiant-point*:—

	α	δ
Eskdalemuir	265½°	+ 52½°
Armagh	266°	+ 55°
Omagh	264½	+ 54½°
Malta	262½°	+ 55°
Weighted mean	264·5°	+ 54·5°

On October 9, 1926, a shower of Draconids from 263° + 54° was observed by Mr. J. P. M. Prentice at Stowmarket. A fine fireball (a member of the shower) which shot at 10h. 16m. p.m., was seen by some thirty other persons, and the radiant was found by Mr. W. F. Denning and the writer at 262° + 55°, and the latter computed an elliptical orbit, first correcting the radiant for zenith-attraction. This orbit, compared with Mr. F. R. Cripps's elements of comet Giacobini-Zinner, is given below:—

	Comet G.-Z. (F.R.C.)	Fireball-radiant (A.K.)
ω	171° 44′ 8″	171° 22′
Ω	195° 56′ 35″	195° 52′
ι	30° 43′ 14″	30° 49′
log q	9·99726	9·9960
φ	45° 47′ 29″	45° 51′

Equinox 1926·0

There was thus no doubt of the identity of the two orbits and the consequent physical connexion of the meteor-stream with the comet. The period of the latter is 6·6 years, and the repetition of the shower from practically the same radiant-position after seven years shows that the recent 'storm' was a return of the Giacobinid display of 1926. It is evident that in the present year the earth passed through a much richer portion of the swarm. Absolute identity of position cannot be expected; the radiant is diffuse and its exact place difficult to define, while observational errors and possible perturbations of the stream must be taken into account.

University and Educational Intelligence

CAMBRIDGE.—The professorship of anatomy will be vacated by the resignation of Prof. J. T. Wilson on September 30, 1934. A meeting of the electors will be held on December 1, 1933. The stipend of the professor is £1,200 a year, or, while the professor holds a fellowship of a College with dividend, £1,000. Candidates for the professorship are requested to communicate with the Vice-Chancellor on or before November 24.

An election to the Pinsent-Darwin studentship in mental pathology will be made in January 1934. The studentship is of the annual value of about £225 and is tenable for three years. The student must engage in original research into any problem having a bearing on mental defects, diseases or disorders, but may carry on educational or other work concurrently. Applications should be sent before January 1, 1934, to the Secretary, Pinsent-Darwin Studentship, Psychological Laboratory, Cambridge.

EDINBURGH.—A letter of appeal for subscriptions has been issued from the office of the Faculty of Medicine of the University of Edinburgh, in connexion with the proposal to establish a lectureship to perpetuate the memory of Sir Edward Sharpey-Schafer, who retired from the chair of physiology on September 30, after occupying it for thirty-four years. It is suggested that under this lectureship a lecture would be given annually or biennially in Edinburgh by a distinguished physiologist to be selected by the Faculty of Medicine. A sum of about £1,000 is required to found the lectureship. Among those who have signed the appeal are the Lord Provost of Edinburgh, the Principal of the University, Sir Frederick Gowland Hopkins, Sir Charles Sherrington, Dr. J. S. Haldane, Sir John Rose Bradford, Sir Henry Dale, Sir William Hardy, the Dean of the Faculty of Medicine and the presidents of the Royal Colleges of Physicians and Surgeons of Edinburgh.

The Kirk o' Field College, a school of adult education adjacent to, and in connexion with, the University Settlement, was opened on October 28 by Sir James Barrie. The College which, it is understood, is the gift of Prof. D. P. D. Wilkie, professor of surgery in the University, was formerly occupied as a picture house, and the building has been remodelled and reconstructed so as to afford excellent facilities for lectures, class-work and demonstrations.

LONDON.—On the occasion of the celebration of Foundation Day, 1933, the degree of Doctor of Science (*honoris causa*) will be conferred on Sir Thomas Barlow and Sir Flinders Petrie.

The following titles have recently been conferred in respect of posts held at the colleges indicated: professor of malarial studies, Sir Samuel Rickard Christophers (London School of Hygiene and Tropical Medicine); reader in pathology, Dr. F. A. Knott (Guy's Hospital Medical School); reader in zoology, Dr. A. J. Grove (East London College).

THE Governors of the Chelsea Polytechnic have elected Dr. B. F. Barnes to be head of the Department of Biology, which will become vacant on January 1 next owing to the retirement of Mr. H. B. Lacey. For the past nine years Dr. Barnes has been senior lecturer in the Department of Botany at the Birkbeck College (University of London).

THE Council of the Institution of Naval Architects has made the following awards: Institution of Naval Architects scholarship (1933), £130 per annum for three years at the Royal Naval College, Greenwich, to Mr. R. E. Tozer, Devonport Dockyard; Earl of Durham prize to Mr. H. W. J. Chislett, Devonport Dockyard; Duke of Northumberland prize (in connexion with the 1933 examinations for National (Higher) Certificates in Naval Architecture) to Mr. A. Stewart, Technical College, Sunderland; 1851 Exhibition Commissioners post-graduate scholarship in naval architecture (1933), £250 per annum for two years, to Mr. H. J. Tabb, Royal Naval College, Greenwich; Sir William White post-graduate scholarship in naval architecture (1933), £150 per annum for two years, to Mr. W. Pratt, Armstrong College, Newcastle-on-Tyne.

WOMEN teachers in the University of Liverpool are in future, it appears, not to be appointed without a stipulation that in the event of their marrying they will resign their posts. The announcement of this ruling has revived old controversies which are discussed in an article by Prof. E. H. Neville, of the University of Reading, in the October number of the *Universities Review*. The crux of the matter is the question how in the absence of such a ruling a university can protect itself against loss of efficiency due to a gradual diversion to domestic preoccupations of an excessive share of a married woman teacher's energies. A solution may be found, it is suggested, in the requirement that a woman teacher should, on marriage, not necessarily resign but revert automatically, without loss of salary or status, to a probationary list. At the end of a probationary period of, say, two or three years, the university would either confirm her or dispense with her services without having to assign and prove specific causes of complaint.

AT a meeting of the Education Circle of the Royal Empire Society, held on October 19, Mrs. Neville Rolfe, secretary-general of the British Social Hygiene Council, opened a discussion upon "Women and Education for Empire Citizenship". Mrs. Rolfe referred to the ever-growing sense of responsibility for Empire well-being generally. Despite, however, the excellent example of many individual women—governors' wives, medical missionaries, the wives of subordinate administrators, etc.—there is still enormous leeway to be made up. The domain of women lies naturally in improving the 'home-life' of the various races of the Empire. For this, not only the basic qualities of sympathy, adaptability, initiative and 'the will to learn' are necessary, but knowledge also and the technique of 'getting that knowledge across' to the other woman, for which again a knowledge of native languages is vital. Miss B. E. Popham, headmistress of the Westonbirt School, Glos., outlined a pioneer effort to be started in January at Westonbirt with the object of meeting this increasing need for Empire service, thus implementing the new constitutional responsibilities of women, when, with the co-operation of various welfare, imperial and educational agencies in Bristol, courses of three and twelve months' training in Empire citizenship from its many angles—geographical, biological, constitutional, ethnographical, economic, medical, etc.—will commence.

Calendar of Nature Topics

Sixth 'Buchan Cold Spell'. St. Martin's Summer

The last of the six periods which Dr. A. Buchan suspected of a tendency to be unseasonably cold occurs on November 6–13. The 90-year daily averages of temperature at Greenwich show no trace of a minimum on these dates, but a continuous fall. The decrease is most rapid between November 3 and 11, between which dates the average falls by nearly 3° F., but this decrease is not a *regular* feature of the climate of Great Britain and the sixth Buchan cold spell, like the other five, cannot be regarded as a real phenomenon. This period includes St. Martin's Day, November 11, which is a frequent subject of folk-lore. According to Shakespeare: "Expect St. Martin's summer, halcyon days", a belief which appears to have even less basis than the Buchan cold spell. In the United States, St. Martin's Day is often regarded as the beginning of the 'Indian summer'. Martinmas is more often a 'key' day, which is supposed either to indicate the character of the coming winter, or to be the opposite of the weather to be expected on the following Christmas. The only saying with which a meteorologist is likely to agree, however, is that

"At St. Martin's Day
Winter is on his way."

Box Turtles begin to Hibernate

Unlike many species in which the habit of hibernation has become stereotyped, the box turtle of North America (*Terrapene carolina*) seems to be experimenting in methods of tiding over the difficulties of winter. In this respect it differs even from its close relative, *T. ornata*, for whereas individuals of the latter species had all dug in and disappeared on the approach of cold weather in late October (according to the observations of Alvin R. Cahn), all the carolinas remained out and active into November (*Copeia*, April 1933, p. 13). Even then their conduct was peculiar. For about a fortnight, several played at hibernation, digging themselves in during the late afternoon and coming out again in the morning. At the end of that time, 19 out of 24 dug themselves in for good.

In the meantime, the remaining five turtles had retreated to a small pond where they lay quiescent in the water, head and legs drawn in, but in such a position that they could get their nostrils out of the water without moving the body. Here they remained all winter, entirely submerging during the coldest weather. A sample of temperature readings gave, air 5·5° C., water 10° C., body temperature of submerged turtles (rectal) 9·5° C., and as a rule body temperature was found to be about 1° below that of the surrounding water (a curious result). One of the five water hibernators made an untimely journey from the water and was frozen to death, but the remaining four survived and ultimately left the pond on April 4. The observations were made at Urbana, Illinois, in 1931.

Birds and Weed-Seed Distribution

One of the problems of autumn on the arable lands is the distribution of weeds by birds, notably finches, feeding on them, and more weeds may occur after the recent dry summer in England, for it has been shown (Ridley) that more seeds are taken as food and passed unharmed through the intestines in a dry season than a wet one. From the droppings of thirty-eight starlings (*Sturnus vulgaris*) in a dry year, fifty-seven plants of six species were raised, while the examination of the same number after a wet summer realised twenty-three plants of four species. The examination of the droppings of twenty-four house-sparrows (*Passer domesticus*) in a dry year revealed fifty-nine plants of four species, and from the same number after a wet summer, eighteen plants of two species. Darwin describes the leg of a woodcock (*Scolopax rusticola*) with a cake of earth adhering to one leg and weighing 9 grains, from which was obtained a seed of the toad vetch (*Juncus bufonius*) which afterwards germinated and flowered.

Newton describes a ball of earth, of 6½ oz., obtained from the leg of a shot red-legged partridge (*Caccabis rufa*) which was kept unbroken for three years, but when placed under a bell-jar and watered, 82 plants consisting of 12 monocotyledons and seven dicotyledons of at least three species, sprung from it. From the excreta of three starlings in 1911, Dr. Collinge grew 27 plants of six species. Of forty wood-pigeons (*Columba palumbus*) killed by a peregrine falcon in Lincolnshire, 25 species of plants were found growing where the falcon had ripped open the crop of one bird, scattering the seeds in it. The crop of a wood-pigeon shot in Lancashire (Milburn) contained 986 rye-grass seeds, 108 clover seeds, as well as 113 clover leaves, 80 weed flowers and 561 barley grains, and some of these doubtless would have survived the grinding of the gizzard.

Pig-Feeding

In the farming calendars of the seventeenth century, November is the month in which to "bring in your swine from the mast and feed them for slaughter". So long as woods and commons could provide natural food, these were used, and hand feeding was only practised when other supplies failed. Consequently the pigs of that time were realised at what we should now regard as very advanced ages, two years being quite common.

The pig, by its rapid breeding and the possibility of working with large numbers, lends itself to experimental treatment. As the raw material of a well-developed industry, the pig's nutritional requirements and powers of converting food into meat have been carefully studied. No factor in breeding, management or nutrition is too small for attention in the attempt to produce a high-grade article at the least cost. The coarse natural fodders of early days have little place in modern intensive production, which goes on regardless of season on almost factory lines. Under these conditions, the protein and mineral requirements and the need for fresh green food take on a fresh importance. At the same time, a uniform type of animal is required which in its general conformation and early maturity would scarcely be recognised as a development from the early forms. As a supplement to scientific work performance, records undertaken on a wide scale have enabled the general level of production to be graded up, in much the same way as milk-recording has improved the yield of dairy herds. Under good management, a bacon pig should now be fit for market five months after weaning, at an expenditure of little more than 4 lb. of dry food for each pound of live weight produced.

Societies and Academies

PARIS

Academy of Sciences, September 4 (*C.R.*, **197**, 565–588). A. LACROIX: The fall of a meteorite in Cambogia on January 9, 1933. Details of the results of a microscopic and metallographic study of the meteorite. GEORGES CLAUDE: The realisation in the near future of a Claude-Boucherot installation on a vessel. ARNAUD DENJOY: Plane cyclic *continus*. L. TCHAKALOFF: A problem of the minimum concerning a certain class of polynomials. A. RATIB: A property of the eddy in the permanent plane movement of an incompressible viscous fluid. WENCESLAS JARDETZKY: The small oscillations of a fluid mass isolated in space. BENJAMIN JEKHOWSKY: The probable number of asteroids that can be discovered with the existing means of observation. L. MÉDARD: The Raman effect of sulphuric acid. H. WUNSCHENDORFF and MME. P. VALIER: The reaction of potassium chromate on manganese chloride in saturated solutions. The products of the reaction are manganese bichromate, $MnCr_2O_7$, and chromium manganite, $Cr_2(MnO_3)_3$. GEORGES BLANC and L. A. MARTIN: The sensibility of the rabbit and of man to the virus of stomatitis of sheep.

September 11 (*C.R.*, **197**, 589–604). H. DESLANDRES: Certain regularities which appear in the succession of solar phenomena. The solar layers have a tendency to divide into equal sectors, which during a time more or less long are sometimes 120° and 90°, or, more often, 60° and 30°. This regular division is that which a homogeneous spherical layer would naturally undergo either by cooling and contraction, or if submitted to an increasing internal pressure, due, for example, to radioactive emissions. A. DEMOULIN: An extension of the idea of conformal transformation to spaces of higher order than two. ETIENNE AUDIBERT and ANDRÉ RAINEAU: The physical state of solid catalysts. For pure substances (metallic copper and nickel, oxides of aluminium, zinc, chromium) the density of specimens showing marked catalytic activity is always less than that of inactive specimens. Thus active copper gave densities 7·60 and 7·54 against 8·9 for inactive copper. The loss of catalytic activity is always accompanied by a progressive increase in the density. From this the conclusion is drawn that for a solid body to exhibit catalytic activity it is necessary that its crystalline lattice should present local irregularities, characterised by an expansion of the lattice. VOLMAR and DUQUÉNOIS: The conditions of fixation of SbO_2H by some monoacid-monoalcohols. PAUL CORSIN: The Devonian flora of Caffiers (Bas-Boulonnais). PAUL WINTREBERT: The embryonic mechanics of amphibians considered in an epigenetic manner as an arrangement of structures and transitory functions.

MELBOURNE

Royal Society of Victoria, July 13. GERALD F. HILL: Notes on Porotermes and Calotermes (Isoptera) from the Australian region, with descriptions of new species. All the species described are of importance in the destruction of seasoned constructional timber or living trees. F. CHAPMAN: A gigantic polyzoan referable to *Lichenopora* from the Miocene of Airey's Inlet, Victoria. A new species of *Lichenopora*, *L. patersonæ*, is described, which is remarkable for the enormous size of the composite zoarium, being second only in point of size to the massive *Cellepora coronopus*, Busk. The related species, *Lichenopora watersi* A. W. Waters described from the Tertiary of Aldinga, South Australia, here re-named, is of much smaller size. F. CHAPMAN: Fossiliferous grits and cherts of presumably Cretaceous age, associated with the Nullagines of Western Australia. A detailed microscopic examination of the glauconite chert of Davis River, Western Australia, shows the presence of abundant coccoliths, whilst casts of Foraminifera in the same rock are compared with generic forms in the Gin Gin chalk, which also contains coccoliths of similar size and form. The glauconitic sandstone of Spinifex Well has characters in common with the rock from Davis River, as in the glauconite casts and occasional coccoliths; there are also crushed Radiolaria in the matrix between the sand grains, somewhat resembling those of Port Darwin, supporting the view that the rock is of Cretaceous age. F. CHAPMAN and I. CRESPIN: New and rare Mollusca from deep borings in Gippsland, Victoria. 8 new species, 1 new variety and 2 species hitherto only known living, of Mollusca found during investigations of core material in the search for oil in East Gippsland, are described. W. J. HARRIS: *Isograptus caduceus* and its allies in Victoria. The significance of *Isograptus caduceus* among Victorian graptolites is indicated and Salter's trivial name *caduceus* is preferred to Nicholson's later emendation *gibberulus*. The characters justifying the creation of the genus *Isograptus* are discussed. *Diplograptus gnomonicus*, Harris and Keble, is placed in a new genus, *Skiagraptus*, which may be included in the Isograptidæ. *Oncograptus* and *Cardiograptus* are distinct genera of the family Isograptidæ. The lower limit of the range of the Isograptidæ in Victoria is provisionally placed as the zone of *Didymograptus extensus* (Zone 4, Arenigian). In Part 2 the new family Isograptidæ is erected. R. T. PATTON: Ecological studies in Victoria (2). The fern gully. This association, which occurs in temperate latitudes, has the characters of tropical rain-forest and is composed chiefly out of tropical representatives. The association is not widespread and is restricted by the factors of rainfall, soil and contour. The leaves are large and coriaceous as is general with tropical plants but the majority have serrate margins.

SYDNEY

Royal Society of New South Wales, Sept. 6. H. J. FROST: Interference method of determining indexes of refraction in the infra-red. The method is used in dealing with a material in the form of thin sheets. Tested with a single sheet of mica of thickness 6·06 μ, it was found that the index of refraction could be determined to a precision of 1 in 500 up to $\lambda = 6\ \mu$. J. C. EARL and A. W. MACKNEY: Action of nitrous acid on dimethylaniline. When nitrous acid is allowed to react with dimethylaniline in the absence of stronger acids, several substances are formed, among them being tetramethylbenzidine and some of its derivatives, *p*-nitrodimethylaniline and a substance apparently identical with one obtained by Cohen and Calvert (*J. Chem. Soc.*, 73, 166; 1898) by treating an ethereal solution of dimethylaniline with nitrogen trioxide. The reactions of this substance have been studied in some detail, but its structure has not yet been determined.

Forthcoming Events

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

Monday, November 6

ROYAL GEOGRAPHICAL SOCIETY, at 3 and 8.30.—Hugh Routledge: "The Mount Everest Expedition of 1933."

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. R. E. M. Wheeler: "Early Civilization and Economics".*

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP), at 8—(at Burlington House, London, W.1).—Dr. L. H. Lampitt: "Fundamental Problems of the Food Industry" (Jubilee Memorial Lecture).

Tuesday, November 7

INSTITUTION OF CIVIL ENGINEERS, at 6.—(Opening Meeting.)—Sir Henry Maybury: Presidential Address.

Wednesday, November 8

GEOLOGICAL SOCIETY, at 5.30.—L. R. Wager: "The Everest Expedition, 1933: Geological Impressions".

ROYAL SOCIETY OF ARTS, at 8.—Dr. Leonard Woolley: "Excavations at Ur".

Thursday, November 9

ROYAL SOCIETY, at 4.30.—Sir Arthur Eddington: "The Masses of the Proton and Electron".

W. T. Astbury and H. J. Woods: "X-Ray Studies of the Structure of Hair, Wool and Related Fibres. (2) The Molecular Structure and Elastic Properties of Hair Keratin".

J. M. Robertson: "The Crystalline Structure of Naphthalene. A Quantitative X-Ray Investigation".

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP), at 7.30—(at 30, Russell Square, W.C.1).—Joint discussion with the Oil and Colour Chemists' Association on "The Function of Paint as a Metal Preservative", to be opened by Dr. L. A. Jordan.

Friday, November 10

ROYAL INSTITUTION, at 9.—Dr. N. V. Sidgwick: "The Shapes of Molecules".

Official Publications Received

GREAT BRITAIN AND IRELAND

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1932–33. Vol. 34. Pp. 78. (Leicester.)

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March, 1933. Pp. 46. (London: H.M. Stationery Office.) 9*d*. net.

Quarterly Journal of the Royal Meteorological Society. Vol. 59, No. 252, October. Pp. 341–431. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Universities Bureau of the British Empire. Report of the Executive Council, together with the Accounts of the Bureau for the Year 1st August, 1932, to 31st July, 1933. Pp. 30. (London.)

Proceedings of the Royal Society. Series A, Vol. 142, No. A 846, October 2. Pp. 361. 18*s*. Series B, Vol. 113, No. B 785, October 2. Pp. 495–554. 5*s*. (London: Harrison and Sons, Ltd.)

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 58, Part 2, September. Pp. 235–442+lxi–clvi+xii+66 plates. (London.) 7*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1541 (T. 3396): Second Report on Tail Buffeting. By Dr. W. J. Duncan, D. L. Ellis and E. Smyth. Pp. 16+35 plates. 1*s*. 3*d*. net. No. 1545 (T. 3362): Principles of the Air Injector. By A. Bailey and S. A. Wood. Pp. 27+16 plates. 1*s*. 9*d*. net. No. 1546 (S. 130): Tests of Full Scale Anchors in various Sea Beds. By Squadron Leader D. F. Lucking. Pp. 6+8 plates. 9*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 11: Further Observations on Atmospheric Ionisation at Glencree. By J. J. Nolan and P. J. Nolan. Pp. 111–128. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

What to See in the Leicester Museum and Art Gallery. Ninth edition. Pp. 16. (Leicester.) 1*d*.

Friends of the National Libraries. Annual Report, 1932–3. Pp. 50+11 plates. (London.)

University of London: University College. Calendar, Session 1933–1934. Pp. lxxviii+12+567+26. (London: Taylor and Francis.)

OTHER COUNTRIES

U.S. Department of the Interior: Office of Education. Bulletin, 1933, No. 4: The Art of Teaching by Radio. By Cline M. Koon. Pp. vii+92. 10 cents. Bulletin, 1933, No. 9: National and State Co-operative High-School Testing Programs. By David Segel. Pp. v+47. 5 cents. Pamphlet No. 36: Week-Day Religious Instruction; Classes for Public-School Pupils conducted on Released School Time. By Mary Dabney Davis. Pp. 34. 5 cents. Pamphlet No. 39: Laws relating to the Releasing of Pupils from Public Schools for Religious Instruction. By Ward W. Keesecker. Pp. 17. 5 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 88: Smithsonian Physical Tables. Eighth revised edition. Prepared by Frederick E. Fowle. (Publication 3171.) Pp. liv+682. (Washington, D.C.: Smithsonian Institution.)

Short History of the Observatory of the University at Leiden 1633–1933. By W. de Sitter. Published on the occasion of the Celebration of the 300th Anniversary of the Foundation of the Observatory. Pp. 48. (Haarlem: Joh. Enschedé en Zonen.)

Smithsonian Institution: United States National Museum. Bulletin 161: The Foraminifera of the Tropical Pacific Collections of the *Albatross*, 1899–1900. Part 2: Lagenidæ to Alveolinellidæ. By Joseph Augustine Cushman. Pp. vi+79+19 plates. (Washington, D.C.: Government Printing Office.) 15 cents.

Proceedings of the Royal Society of Victoria. Vol. 45 (New Series), Part 2, 1st August. Pp. 33+261. (Melbourne.)

Transactions of the Mining and Geological Institute of India. Vol. 28, Part 2, August. Pp. 67–176+9 plates. (Calcutta.) 2.8 rupees.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 23: Variation in the Moisture Content of Baled Indian Cotton with Atmospheric Humidity. By Dr. Nazir Ahmad. Pp. ii+34. 1 rupee. Technological Bulletin, Series A, No. 24: Technological Reports on Standard Indian Cottons, 1933. By Dr. Nazir Ahmad. Pp. iii+94. 1.8 rupees. (Bombay.)

Records of the Geological Survey of India. Vol. 66, Part 4. Pp. 405–534+xl+plates 22–28. 2.12 rupees; 5*s*. Vol. 67, Part 1. Pp. 134+2 plates. 2.12 rupees; 5*s*. (Calcutta.)

Records of the Indian Museum. Vol. 34, Part 3, September 1932. Pp. 229–356+plate 18. 2.12 rupees; 5*s*. Vol. 34, Part 4, December 1932. Pp. 357–573+plates 19–20. 2.12 rupees; 5*s*. Vol. 35, Part 1, March 1933. Pp. 123+3 plates. 2.12 rupees; 5*s*. Vol. 35, Part 2, June 1933. Pp. 125–266+plates 4–5. 2.12 rupees; 5*s*. (Calcutta.)

Memoirs of the Indian Museum. Vol. 9, No. 6: A Revision of the Fissilabioidea (Cordulegasteridæ, Petaliidæ and Petaluridæ) (Order Odonata). Part 2: Petaliidæ and Petaluridæ and Appendix to Part 1. By Lieut.-Col. F. C. Fraser. Pp. 205–260. 2.2 rupees; 4*s*. Vol. 12, No. 1: Annelida Polychaeta of the Indian Museum, Calcutta. By Prof. Pierre Fauvel. Pp. 262+9 plates. 9.14 rupees; 16*s*. 6*d*. Vol. 12, No. 2: Classification, Binomics and Evolution of Homalopterid Fishes. By Dr. Sunder Lal Hora. Pp. 263–330+plates 10–12. 2.10 rupees; 4*s*. 9*d*. (Calcutta.)

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 10, No. 1. Pp. 81. (Tokyo: National Research Council of Japan.)

Southern Rhodesia: Geological Survey. Bulletin No. 23: A Preliminary Report on the Mineral Springs of Southern Rhodesia. By H. B. Maufe. Pp. 78+3 plates. (Salisbury.) 4*s*.

Ministry of Agriculture, Egypt. Report on the Work of the Plant Protection Section during the Period 1925–1931. Pp. 49. (Cairo: Government Press.) 5 P.T.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 125: Hair Weight Target Diagrams in Cotton Breeding. By C. H. Brown, Abd el Ghaffar Selim and Ahmed Youssef. Pp. 3+12 plates. (Cairo: Government Press.) 5 P.T.

U.S. Department of Agriculture. Circular No. 281: The Survival of European Corn-Borer Larvæ in Barns and other Storage Places. By L. B. Scott and L. H. Patch. Pp. 7. 5 cents. Circular No. 290: Grades of Peat and Muck for Soil Improvement. By A. P. Dachnowski-Stokes. Pp. 31. 5 cents. Technical Bulletin No. 377: Character and Behavior of Organic Soil Colloids. By M. S. Anderson and Horace G. Byers. Pp. 32. 5 cents. (Washington, D.C.: Government Printing Office.)

American Psychical Institute. Bulletin 1: An Instrumental Test of the Independence of a "Spirit Control". Pp. iii+95. (New York City.) 2 dollars.

Suggestions for Pheasant Management in Southern Michigan. By Prof. Howard M. Wight. Pp. 25. (Lansing, Mich.: Department of Conservation.)

Travaux du Laboratoire de Microbiologie de la Faculté de Pharmacie de Nancy. Fascicule 6. Pp. 164. (Nancy.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 13, No. 8: Deep-Sea Isospondylous Fishes; Two New Genera and Four New Species. By William Beebe. Pp. 159–167. Vol. 16, Nos. 1, 2 and 3: Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. No. 1: Introduction; No. 2: Family Alepocephalidæ: No. 3: Family Argentinidæ. By William Beebe. Pp. 147. (New York City.)

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1931, under the direction of Dr. S. K. Banerji. Pp. iv+165+5 plates. (Delhi: Manager of Publications.) 12.6 rupees; 20*s*.

CATALOGUES

Classics of Science: Books illustrating the Progress of Scientific Discovery. (Catalogue 29.) Pp. 80+4 plates. (London: E. P. Goldschmidt and Co., Ltd.)

X Ray Camera. (Ron 33.) Pp. 2. Light Sources. (Liso 33.) Pp. 8. (Delft: P. J. Kipp en Zonen.)

Bulletin des publications nouvelles. 1er trimestre, 1933. Pp. 40. 2e trimestre, 1933. Pp. 24. (Paris: Gauthier-Villars et Cie.)

Watson's Microscope Record. No. 30, September. Pp. 24. (London: W. Watson and Sons, Ltd.)

Fine Chemicals. Pp. 72. (London: Harrington Bros., Ltd.)