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British Aviation.

THE peaceful penetration of all fields of thought and activity by the spirit and method of scientific inquiry is well illustrated in the extent to which eminent politicians, and ministers of the Crown, now frequently refer to the need for relying on scientific knowledge for our material salvation. This is strikingly exemplified in the speech delivered by Mr. F. Montague, Under-Secretary of State for Air, on Mar. 18, in presenting the Air Estimates. Gone is the old tradition of regarding decimal points as mere 'damned dots' of no importance, and in its place we have the 'new style' speech bristling with technical details that one might expect only from the mouth of the most hard-headed expert, as a justification to democracy for the expenditure of its hard-earned money. In a sense this change should occasion no surprise. The Air Force is a new wing, and, unlike the Army and the Navy, has no long evolutionary history behind it. It is an upstart that has won eminence by a series of scientific and technical strokes. It can only be developed by technical knowledge; it can scarcely even be conducted without it.

The total of last year's estimate was £16,960,000, as against for this year a total of £17,850,000, an increase due in the main to the provision of up-to-date equipment, essential alike for safety and efficiency, the growing needs of civil aviation, and outlay in scientific research. It can scarcely be contended that the air policy of Great Britain is anything but limited and unprovocative. If consideration is given to comparative air strength, and to the trend of air expenditure of such powers as France, Italy, and the United States of America, it becomes clear that the Air Force of Great Britain is substantially exceeded in first-line strength by these three other powers. In this connexion it should be borne in mind that our overseas garrisons, in the Middle East, and in India, make a much greater call than those of other countries. On the basis of metropolitan strength our standard is half-power approximately, compared with our nearest neighbour. In reply to a question by Sir Samuel Hoare on April 16, the number of aeroplanes maintained by the respective nations, now, and five years ago, were stated to be :

	1925	1930
Great Britain	630	780
France	1280	1310
U.S.A.	750	950
Italy	600	1100

The extension of the Air Force is no mere

expansion in the ordinary sense. To an increasing degree it is being used in the military field in substitution for ground forces, with a consequent considerable economy. No other nation has yet pursued this policy of replacement to the extent to which Great Britain has done. The change wrought by this kind of transformation is well illustrated by the case of Aden, where for the last two years there has been an air squadron of twelve machine strength and a total complement of 200 men, in replacement of one British and one Indian battalion of infantry with a total strength of about 16,000. Even as a mere aid to transport the effect of the aeroplane is of no mean order. During the Palestine riots the prompt arrival of fifty soldiers by air did much to stem the movement. Aircraft were used to drive off attacks by Arabs on isolated Jewish colonies before the arrival of ground reinforcements ; in fact, according to Mr. Montague, as an instrument for quelling insurgents in almost inaccessible regions of the Far East, the Air Force has been invaluable.

The multitude of non-military uses to which these aircraft have been put is almost incredible : emergency assistance in cases of a medical and surgical character, particularly in India ; rescues on British coasts and in the Middle East ; warnings of floods in India ; survey photography ; participation in the anti-locust campaign in the Sudan ; fishery protection against poaching by foreign vessels on the east coast of Great Britain ; co-operation in the search for overdue fishing craft after gales. These are some of the diverse activities that the Air Force has been called upon to perform. Meanwhile, numerous reconnoitring flights are being undertaken across Africa, from north to south, with the object of trying out weather conditions for flying, and to examine the possibility of maintaining prearranged time tables under adverse conditions. In one such test flight, aircraft from Cairo, after a journey of 11,200 miles, returned late by five minutes only on the scheduled time.

The part of the Under-Secretary's speech, however, that dealt with the more purely scientific side could have been understood by only a small fraction of his hearers. The Minister explained in detail a large number of the highly technical problems that are being undertaken under the heads of research and development at various research stations. He described, for example, the scientific nature of the problem of noise in aircraft, the analysis of its source, how it is measured, and the investigations that are being pursued with the object of reducing it. He explained the nature of aerodynamic interference of aeroplane parts, and its effective wastage of horse-power ; and he went on to describe in scientific terms the method of air-tunnel testing of models, and its limitations as regards scale-effect. This enabled him to justify the expenditure on a larger wind-tunnel and a new high pressure tunnel that are being constructed, and to explain their underlying principles. Engine research, wireless rotating beacons for direction finding, and many other new scientific developments, also found their place in a remarkable speech.

To scientific men in Great Britain it is especially gratifying to realise that their work, in its most technical form, has penetrated into the First Chamber in the land. If, however, the House of Commons is to maintain itself, in these difficult circumstances, as a stage for critical and intelligent discussion, it is vital that members of that body who possess a scientific training should meet on common ground. It is to be hoped that this may be provided by the new Parliamentary Science Committee.

The Platinum Group Metals in South Africa.

The Platinum Deposits and Mines of South Africa. By Dr. Percy A. Wagner. With a Chapter on the Mineragraphy and Spectrography of the Sulphidic Platinum Ores of the Bushveld Complex, by Prof. D. H. Schneiderhöhn. Pp. xv + 326 + 38 plates. (Edinburgh and London : Oliver and Boyd, 1929.) 21*s.* net.

IN this book we have a complete history of the platinum group of metals from their genesis and mineralogy to the mining companies that exploit them. Dr. Wagner—and one realises with deep regret that this is the last time we shall receive such another work from his hands—speaks with authority, the authority that comes alone from personal experience. He also secured the services of Dr. Schneiderhöhn, who contributes a valuable chapter abounding in admirable photomicrographs on the mineragraphy, spectrography, and genesis of the platinum-bearing nickel-pyrrhotite ores of the Bushveld Complex. In addition to plates, there are 37 text figures.

Production of the platinum group of metals began in South Africa in 1921 when the recovery of 'osmiridium', a concentrate composed of several minerals, was begun in earnest in the Far East Rand. The distribution of the 'osmiridium', principally derived from the Main Reef Leader, corresponds very nearly with that of the gold, but

at the best (in Modderfontein 'B') was only 1 oz. per 1212 tons of conglomerate milled in 1924. It is entirely a by-product to the winning of the gold. In the central part of the Transvaal, however, the matter is different, for in 1925 the discoveries in the norite of the Bushveld Complex were made; a rock series which "probably contains in the aggregate more platinum than all the rest of the earth's crust accessible to man". Hence it is with this "vast composite body of plutonic and volcanic rocks" that Dr. Wagner's book is for the greater part concerned.

In general characters the Bushveld Igneous Complex is well known to students of African geology; it is a basin-shaped sheet or lipolith, 2-3½ miles thick and wonderfully differentiated into sheets and lenses simulating stratification. Of these layers, the Merensky horizon, most important in the Rustenburg district, claims a large section of the book, which is dedicated with an obvious regard to its discoverer. The Merensky Horizon contains the Merensky 'Reef', a pseudo-porphyritic pyroxenitic diallage norite, occasionally "almost uncanny" in the regularity of its dip and strike. In many places 'chrome bands' are important features of the horizon. This occupies six chapters, and it is impossible to sum up in brief space the immense amount of detail with which these are crowded. It deserves six chapters, since Dr. Wagner concludes its deposits are "among the world's greatest concentrations of mineral wealth".

Dr. Schneiderhöhn's contribution to our knowledge of the nickel-pyrrhotite ores is also very detailed. The elaboration of the research is shown by the method employed. It was found that microscopic work failed and ordinary analytical procedure proved impracticable to ascertain which minerals contained platinum and to what extent. Accordingly, isolation of individual grains was effected by means of a motor-driven drill resembling that used by dentists and minute fragments bored out under the microscope. These were then vaporised in an arc-lamp and the ultra-violet part of the spectrum obtained by the use of a quartz spectrograph. It was found that the chalcopyrite (the last sulphide to be formed) and millerite contained no platinum, which was present in the nickeliferous pyrite, pyrrhotite and pentlandite, these also containing cobalt. Other results of interest are recorded, for which the reader is referred to the book.

A short chapter is devoted to the Great Dyke of Southern Rhodesia, and it is thought that the small quantity of platinum and associated pebbles of chromitite of the Somabula field near Gwelo were derived from it. In a few pages the seemingly disappointing nickel-copper occurrences in the gabbro-norite (a phase of the Karroo dolerites) of Insizwa and Tabankulu, and the more unusual ones of the Waterberg district in the central Transvaal, are described. In the latter, the metal is found in quartz lodes along faults which cut felsites and tuffs of the Bushveld Complex, and is remarkable for its extremely erratic distribution, some assays giving extraordinarily high figures, "probably the highest" ever known.

The book concludes with short accounts of mining methods and mining companies, marketing conditions, and costs of production, among which one notes that to produce 1 oz. of platinum from the rocks of the Merensky Horizon costs about £6; the average content is roughly 5 dwt. per short ton.

It is somewhat surprising to read that approximately 70 per cent of the world's total platinum supply is used for jewellery, whereas before the War it was employed for technical purposes. For the latter, substitutes have now been found.

This is a book for geologists and mining engineers alike, and will doubtless remain for long the standard work on its subject.

JOHN PARKINSON.

Political Science.

Research in the Social Sciences: its Fundamental Methods and Objectives. By Robert Ezra Park, Allyn Abbott Young, Clark Wissler, Robert Emmet Chaddock, Robert Sessions Woodworth, Roscoe Pound, Arthur Meier Schlesinger, John Dewey, Charles Austin Beard. Edited, with an Introduction, by Wilson Gee. Pp. xi + 305. (New York: The Macmillan Co., 1929.) 8*s.* 6*d.* net.

THIS book is a series of more or less authoritative essays on the several branches of social science and exhibits wide variation in merit, ranging from vague meandering through wordy labyrinths leading nowhere, up to real sublimity and noonday clearness of thought. A sample of the labyrinthic uncertainty meets us at the very outset in the first essay, wherein Teggart is said to have stated the difference between history and the other sciences in one "fine phrase". He said: "Science deals with objects, entities, things, and their relations; history concerns itself with events". One could, of course, debate until doomsday on such

a theorem, either for or against, without tolerable approach to a satisfactory, definite, and agreed solution. No very clear light is thrown on the matter by the further cryptic utterance : " Events happen ; things do not ". Hence we may conclude that science deals with things that do not happen ! All this may be fine phraseology, but does not appear very helpful to the hopeful student struggling to make his way over the wide and troubled seas of sociology. Moreover, the above quotation from Teggart is supposed to note the difference between history and the " other sciences ", and this would seem to imply that history itself is a science. Whence it follows that one particular science, history, deals with events that happen, whilst the other sciences treat of things that do not happen ! Let us find what solace we can in this methodological labyrinth.

Is history a science ? Taking one wild leap over all the intervening essays on economics, anthropology, statistics, psychology, jurisprudence, history, and philosophy, we come to the last one, on political science, by far the best of the whole series, both in vigour and clearness of thought and in helpful and stimulating suggestiveness. Alighting breathless after a long jump, the above query greets us. Prof. Charles Austin Beard says :

" Ever since Newton discovered the law under which the stars swing in their orbits imaginative thinkers have toyed with the possibility of reducing history to a science, and thus, automatically, the scattered and disjointed operations of mankind grouped for convenience under the head of politics."

Many great thinkers and the scientific spirit of the modern age have fed this ambition. Henry Adams said that every professor who has tried to teach the doubtful facts we now call history must have felt that, sooner or later, he or another would put order in chaos and bring light into darkness. Does it really matter very much ? It all turns on our definition of science, and we have had to abandon every attempt to be very precise or inelastic in any definitions anywhere. Whether or no we can bring history and therefore politics within the orbit of true science, there must always be a vast borderland where one hovers between science and no-science or between science and philosophy, a region that must be closely scrutinised by all men.

Prof. Beard very ably discusses some of the difficulties in the path of recognising political science as such. These seem to consist mainly in the first place in unsuitable materials to work on, and secondly in biased minds to work with. Looking back over the political literature of the past two hundred years, he thinks that the major part of it, even of the greatest writers, is conspicuously partisan in spirit, designed to defend some existing political order or to discredit it in the name of something that is thought to be better ; and " if such be the state of our literature, what can be said of the state of our minds ", a confused mix-up of convictions, prejudices, kinks, predilections, hunches, grouches. The first difficulty is probably contained in or a corollary to the second, and the defective mind has presided over all the works of the greatest political thinkers at least for the past two hundred years. Possibly, if we could glance backward two thousand four hundred years instead of only two hundred, and thus include Aristotle, we might luckily find at least one mind capable of rising above narrowness and prejudice. But, taking the lesser sweep of backward vision, is it really the fact that all our writers and political orators within that period have suffered from these mental infirmities ? Must we thus stigmatise such men as Burke, Chatham, Milton, or John Locke ? Perhaps they have not been strictly scientific in the sense in which we understand the term to-day ; they have at all events been above or in advance of the general level of political thinking in their time ; they have exhibited in a high degree political wisdom and sagacity, though whether this is the same thing as political science we need not stay here to inquire ; and they have made wonderful contributions to the practical task of building up that noble edifice, the British constitution, and in enunciating the principles of sound government.

Prof. Beard admits that these real or imaginary defects, both in the materials requisite for constructing a science of politics and in the mental equipment available for the purpose, are not peculiar to the political and social sciences ; they have been met with in the purest of the physical sciences, and do not necessarily and completely inhibit the ultimate hope of achieving a true science of politics, if we really are desperately anxious to make politics scientific in form and spirit. A more serious difficulty, according to the author, is the utter futility of such a science, that is, if it is to attain to any sort of capacity for prediction, able to trace the trajectory of future political events. Could, for example, political happenings have been safely predicted in any university in Germany in regard to the period 1910–20, without placing the professors under imminent risk of being

stoned or burnt by an enraged populace? Also that which is plotted in the curve would be inexorable. "If we could get enough knowledge to make a science of politics, we should imprison ourselves in an iron web of our own making." We could not by any effort prevent or change anything in the prognosis.

Waiving the question whether such inexorable predictability is a necessary quality of genuine science, must we cease our search for sufficient knowledge to make a science of politics for fear that we should thus be self-condemned to feverish arachnidal activity and become hopelessly enmeshed in iron webs? Reasoning on the analogy of astronomy, one could easily reach a *reductio ad absurdum*. Astronomical eclipses are predictable and inexorable, but we do not call such knowledge useless or set it up as an argument against the admission of astronomy to the realm of science. In the political sphere, where phenomena are much more under human control, especially in view of the tremendous powers now placed in the hands of modern governments, it does not seem that prognosis, if attainable, need always be inexorable; or at least, if we could not change coming events we could possibly in some measure provide for or against them, or even introduce modifying factors.

The kernel, however, of Prof. Beard's essay is much more important and less controversial than these preliminary excursions. He maintains very justly that what is really needed to-day is creative thinking in the political sphere, and it is immaterial whether the results of such thinking are called political science, theory, philosophy, descriptive politics, or merely political thought. We very urgently need intelligence applied to political data, and the main questions are: What is intelligence? How can it be developed and enriched? What are the conditions favourable to its exercise on the data of politics? We are treated to a brilliant disquisition on the subject of intelligence in which the so-called American intelligence tests are reduced to absurdity, and even the President of the United States is severely handled and called upon to explain himself. President Hoover had recently ventured to include the following very innocent-looking little contribution to political science in an address to the engineering profession:

"The engineers have contributed a great purpose in the United States—a purpose that is applicable to all branches of public life; not only their service but the engineers' mode of thinking by which there must be determination of exact facts, followed by a proper presentation of these facts in their proportional weight before any determination is made of either public or private issue. That should be the basis of government action."

This might well pass as a general description of scientific method, but Prof. Beard finds it bristling with difficulties when applied to politics, questions the terminological precision of nearly every word, and pulverises the whole statement with a heavy barrage of dictionary references.

No, there is no science of politics, and there is not much room even for the application of scientific method. It remains to consider the most favourable conditions for that hard creative thinking which seems to be the only thing left to us. Among these leisure and freedom are of primary importance though not always essential, and they do not necessarily induce thought. The intellectual atmosphere of the universities is not always favourable and might well be improved in various ways:

"There are in the university too many charming friends who must not be offended; too many temporal negotiations that call for discreet management; too many lectures to be delivered; too many promotions requiring emphasis on the amenities of life rather than on its thinking processes; too many alumni eager to apply in 1928 what they learned in 1888; too much routine, not enough peace; too much calm, not enough passion; above all too many sacred traditions that must be conserved; too many theories, not enough theory; too many books, not enough strife of experience; too many students, not enough seekers. Yet with all its handicaps to thought the university must supply the training for most of our political thinkers, and with all its limitations it furnishes the most favourable climate for creative work in America."

Practical experience with government as a going concern is desirable if it can be combined with aloofness from its immediately practical ends and freedom from financial or commercial entanglements or other interests. One may add as a final stimulant to creative political thinking a clear apprehension of the goal aimed at and of some of the problems which call now for urgent solution. Prof. Beard propounds several of these, and his list is remarkable in the height and depth of its range. If, as Edmund Burke said in regard to the conciliation of the American colonies, the mere attempt would be an undertaking that would ennoble the flights of the highest genius, so the mere contemplation of some of these momentous problems, on which depends the destiny of mankind, may well stir the mind and imagination to the supremest exercise of thought—the first essential in any effective action. W. G. LINN CASS.

The Sea and all that in it is.

The Seas: our Knowledge of Life in the Sea and how it is Gained. By Dr. F. S. Russell and Dr. C. M. Yonge. Pp. xiii + 379 + 127 plates. (London and New York: Frederick Warne and Co., Ltd., 1928.) 12*s.* 6*d.* net.

THIS handy volume, comprehensive and competent, illustrated generously and luminously, is easily the best of the smaller books dealing with the sea and all that in it is. The only English book that can hold a candle to it is Sir John Murray's little volume in the Home University Library, but it is much smaller and necessarily restricted in its illustrations. With larger treatises, the best of which is "The Depths of the Ocean" by Murray and Hjort, the present compact volume does not compete, but the gist of the matter is all here; and the whole story of oceanography is admirably told.

We congratulate Dr. Russell and Dr. Yonge on a first-class piece of work, neither too popular nor too technical, a book of wide vistas, illumined with biological ideas. It is written *con amore*, and we find the freshness and sparkle of the sea in its pages. It is one of the most successful of recent ecological books, not only in its grip and clearness, but also because it is written educatively, building up from the familiar to the extraordinary, and from the general to the detailed, yet all as if the authors were thoroughly enjoying themselves, as their readers certainly do.

After a general introduction on man's intellectual struggle with the problems of oceanography, "The Seas" starts with the life of the shore, the depths, and the open waters. There are chapters on the swimming animals and the drifting animals, while the strange byway followed by borers is separately discussed. Coral reefs prove as fascinating as ever, and then comes a fine chapter on colour and phosphorescence. A discussion of different modes of nutrition among marine animals is followed by chapters on sea-water and on the oceanic changes that are correlated with the seasons. The authors pass on to methods of oceanographical research, and then come several predominantly practical chapters devoted to fisheries, shellfish industry, fishery research, and the diverse products of the sea. Great restraint is shown throughout, for many of these subjects are very apt to run away with their expositors.

It is difficult not to be extravagant in praising the well selected illustrations, many of which, including the coloured plates, are due to Mr. W. J. Stokoe, who displays brilliant skill. It is not only that the illustrations are beautiful and fresh; we wish especially to praise their educativeness. They do not merely adorn the tale, they continue it. The altogether admirable volume, which we wish to recommend unreservedly to all interested in the sea, is appropriately dedicated to Dr. E. J. Allen of Plymouth, the inspirer of so many investigations in marine biology.

Our Bookshelf.

Die Rohstoffe des Tierreichs. Herausgegeben von Ferdinand Pax und Walther Arndt. Lieferung 2. Pp. 161-400. 18 gold marks. Lieferung 3. Pp. 160. 12 gold marks. (Berlin: Gebrüder Borntraeger, 1929.)

THE second part of this interesting work is composed of five chapters. The first chapter is devoted to a consideration of the shells of molluscs as ornaments, amulets, as material for the preparation of cameos, as money, trumpets, lamps, etc. The second chapter deals with the electrical deposition of metals on the exterior of animals such as snakes, the sea horse (*Hippocampus*), etc., by which successful permanent preparations are possible, and in an appendix the method of impregnating similar animals with paraffin wax in order to obtain dry preparations for museum purposes is briefly described. The following chapter is on animal substances employed in powdered form as grinding or polishing materials, as tooth powder (for example, cuttle bone), and on skins, such as those of fishes used in smoothing and polishing ivory and other materials. The chapter on insect galls describes the principal kinds of galls found in commerce, with analyses of the more important.

The final chapter of this part is on colouring matters of animal origin, especially cochineal and the purple from the hypobranchial gland of certain molluscs. An account is given of the history of these purple dyes, the constitution of one of which was determined by Friedlander, who prepared from 12,000 specimens of *Murex brandaris*, collected at Trieste, 1·4 gm. of the purple dye and showed it to be a brominated indigo (dibromindigo). An adequate account is added of the production, preparation, and nature of sepia.

The third part of this work is concerned entirely with the formation, extraction, qualities, and uses of the numerous forms of fat, oil, and wax, and of shellac. Details are given of melting points and other physical properties and of the chemical constitution of many of these substances, and reference is made to the more usual adulterants and to the methods by which their presence may be ascertained.

Of most of the substances dealt with in these two parts, there is an adequate historical account as well as particulars of the amounts of many of them exported or sold in given years, and the areas principally concerned in their preparation and in their use. At the end of each section is a helpful bibliography.

The Atom. By Prof. G. P. Thomson. (The Home University Library of Modern Knowledge.) Pp. 252. (London: Thornton Butterworth, Ltd., 1930.) 2*s.* 6*d.* net.

THE needs of the general scientific worker and the scientifically minded layman wishing to acquire a general knowledge of the advances and spirit of contemporary physics are very fittingly met by Prof. G. P. Thomson's admirable little work. The author has, in a short compass, presented an up-to-date survey of physical theory and its bearing on chemistry with an extensiveness which would not be suspected from the title. Starting with the spectrum and not forgetting cosmic rays, the reader is led through the fundamental laws of chemistry to the electron, isotopes, positive-ray analysis, crystal structure, and radioactivity to energy units, the conception of the quantum, and its development on the older theory.

The most interesting part of the book is, however, that devoted to the recent wave theory of de Broglie, its development by Schrödinger, and the ideas underlying the electron wave. The clear logical treatment throughout is assisted by a variety of happily chosen analogies. A surprising number of topics come under notice; the reader will not look in vain for reference, necessarily superficial, to Heisenberg's uncertainty relation, Pauli's principle, the work of Davisson and Germer on the electron wave, Dirac and Darwin's work on the spinning electron, and Eddington's recent treatment of $hc/2\pi e^2$. The modifications of the older Bohr orbit scheme necessitated by the wave mechanics are explained, and the rôle of the electron in chemical theory is interpreted. The book concludes with some considerations on the philosophical aspect of modern physics.

Mathematics has been entirely avoided, the author confining himself mainly to those concepts which lend themselves to physical interpretation. Due prominence is given to the fundamental part played by probability. The reader will not appreciate the co-ordination and development of Heisenberg's matrix mechanics and Dirac's analysis with the wave mechanics; these being unsuited to verbal explanation are wisely omitted. The possibly one-sided view resulting is largely offset by the clarity of the wave picture. A difficult task has been accomplished in a manner which will repay the study not only of the non-specialist but also of the general scientific worker who has no wish to be lost in a mathematical fog. N. M. BLIGH.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland: a Record of the Work done in Science, Literature and Art during the Session 1928–1929 by numerous Societies and Government Institutions. Compiled from Official Sources. Forty-sixth annual issue. Pp. vii + 413. (London: Charles Griffin and Co., Ltd., 1930.) 18*s.* net.

Is this to be the last issue of this useful annual? Unless further support is received the publishers announce that they cannot continue its publication, at least in its present form, and it is proposed to economise by printing only the titles of papers which have been published as well as read. We doubt, however, if this would enable the publishers to reduce the price of the volume substantially and in these days of heavy expenses it is the high price which, we believe, prevents a wider sale. If the "Year-Book" as it is cannot continue, we would suggest an annual volume omitting all the lists of papers. Such a classified directory giving the names and addresses of learned societies and including, as now, their officers, brief particulars as to meetings, publications, and conditions of membership, would be useful and the information could be kept thoroughly up-to-date if the volume was issued about May. For the present, however, we must be grateful to the publishers for continuing their efforts and also to the officers of societies who have given the time and trouble to enable the "Year-Book" to retain its official character.

Joy in Work. By Henri de Man. Translated from the German by Eden and Cedar Paul. Pp. 224. (London: George Allen and Unwin, Ltd., 1929.) 8*s.* 6*d.* net.

THE English title is to be preferred to the original German, "Der Kampf um die Arbeitsfreude"; for joy in work is spontaneous, not the result of struggle. An interesting thesis is somewhat marred by extravagant phrasing; insensibly we think of "the devil rebuking sin" when the author inveighs against German books where "the old grist is reground into a new and jawbreaking terminology"; let the following from "Joy in Work" suffice—"certain kindred antinomies in proletarian characterology", which doubtless well expresses the Teutonic original. The subject is treated under the aspects of "Impulse" and "Hindrances" to such joy, and it is based on reports from workers, in response to a questionnaire furnished by the author. He discusses medieval craftsmanship and modern mechanised labour, the merits and demerits of payment by time and by results, and distinguishes the factors that influence Teutonic psychosis from those that affect the Anglo-Saxon races. He wisely remarks that "payment by the piece need only endanger the quality of the product when piecework rates and minimum wages are so low that the worker has to speed-up immoderately in order to earn a subsistence"; and suggests that the owner's profits should "increase only in proportion to the increase in the workers' wages". P. L. M.

Gmelins Handbuch der anorganischen Chemie. Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. *System-Nummer 59: Eisen.* Teil A, Lieferung 1. Pp. 224. (Berlin: Verlag Chemie G.m.b.H., 1929.) 33 gold marks.

THE section of Gmelin's 'Handbuch' dealing with iron (Part *A*) is an ambitious work to which eight specialists have promised to contribute. The 224 pages now issued include a remarkable historical bibliography covering 59 pages, with nearly 2000 references, about 120 pages on the occurrence of iron, and in conclusion some 40 pages on the preparation of pure iron in various forms.

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.*]

Age of the Earth.

I HAVE just finished reading a most interesting book on "The Universe Around Us", by Sir James Jeans. It opens up a complex and abstruse subject with admirable clearness, so that even a geologist possessed of very little mathematics can find his way through it without too much difficulty. The ease with which in this brilliant book millions of millions of stars are marshalled and their history outlined for millions of millions of years inspires no little awe and a large amount of envy in the breast of a plodding geologist who keeps to the solid earth. If the book contained only the inspiring visions of an astronomer in regard to the origin and the fate of the universe around us a geologist might refrain from comment; but at several points the history of the earth and its inhabitants is touched upon, giving him a right to a word of criticism.

Sir James in a page or two suggests that the earth began about 2,000,000,000 years ago as a globe of intensely hot gas, which gradually cooled down, becoming first a liquid, then plastic, and finally an outer crust solidified, "rocks and mountains forming a permanent record of the irregularities of its earlier plastic form". Life probably began on the earth about 300,000,000 years before the present.

A generation ago, when Lord Kelvin laid down the law as to geological time, this allowance would have seemed very liberal; but the discovery that the age of certain rocks can be determined by an analysis of the radioactive minerals they contain has completely changed our point of view. 2,000,000,000 years is decidedly too short a time for Pre-Cambrian history if the earth began in a gaseous form; and life existed far earlier than 300,000,000 years ago.

These points are easily proved by a brief study of the Grenville Series of Ontario and Quebec and of the Laurentian granite and gneiss which have erupted through it, since radioactive minerals are found in pegmatite dikes connected with the granite.

AGES OF PEGMATITE IN ONTARIO AND QUEBEC.

Localities.	Determined by T. L. Walker.[1]	Determined by H. V. Ellsworth.[2]
Parry Sound	1,274,000,000 years	1,179,000,000 years
Villeneuve	1,293,000,000 ,,	1,189,000,000 ,,
Cardiff Tp.	1,239,000,000 ,,	1,299,000,000 ,,
Butt Tp.		1,130,000,000 ,,

The localities are scattered over 200 miles from west to east, and it will be observed that the age of the pegmatites does not differ greatly at the various points and that the two analysts are not far apart in their determinations. We may conclude that the uraninites of the pegmatites were formed about 1,230,000,000 years ago.

The pegmatite dikes are the latest phases of the molten granite which heaved up the rocks of the Grenville Series into domes forming important mountain chains which covered many thousand square miles, and the Grenville Series must have been solid rock long before this took place.

The Grenville rocks are now crystalline limestones, gneisses, and quartzites, but were originally ordinary limestones, shales, and sandstones, which were deposited as limy material, mud, and sand in a shallow sea.

The series is very thick according to Dr. Adams, who measured 17,824 feet in one section and 94,406 feet in another; and to the age shown by the radioactive minerals must be added many millions of years for the deposit of a great geological formation, its consolidation, and the thrusting up of the widespread Laurentian mountains.

But we are still far from the beginning. Before the Grenville sediments could be laid down the earth's crust must have been firm and solid to form shores and sea bottoms of a permanent kind, and must have been cool enough to allow rain to fall and rivers to bring down mud and sand into the sea. If the earth ever passed through a stage of heat and plasticity, that was completely over before the beginning of the Grenville sea; and the water was cool enough to allow algæ or other lowly plants to thrive, since in places the sediments contain several per cent of carbon, now in the form of graphite.

Life had already appeared in the sea.

The Grenville rocks have been chosen for this study because they are well known and are dated by analyses of radioactive minerals, but they are probably somewhat surpassed in age by the Keewatin, which is mainly volcanic, but with important amounts of sediments, and the Coutchiching, which is wholly sedimentary. No uraninites have yet been found in the granites which penetrate them.

Taking all of these formations together, we have a known area of 1,000,000 square miles of cold and rigid rocks with well-established lands and seas in North America 1,300,000,000 or 1,500,000,000 years ago, with no suggestion of physical conditions fundamentally different from the present.

The oldest rocks in Brazil, South Africa, Australia, India, Scandinavia, and Scotland, judging from what I have seen of them, include similar sediments to those of the Grenville and Keewatin in Canada, though not on so broad a scale. In Holmes's interesting discussion of the "Age of the Earth", the Lower Pre-Cambrian of West Australia is stated to be 1,260,000,000 years old, which fits well with the age of the Grenville.

There were, then, solid land surfaces not too warm for lakes or seas to exist in all the continents in the earliest times known to the geologist; and there is, in fact, no geological evidence that the world ever was molten. If our globe passed through intensely hot gaseous, liquid, and plastic stages, the cooling had run its course completely many millions of years before the pegmatite veins penetrated the Grenville sediments; and the cold continents had undergone at least one major mountain-building revolution at an earlier time than 1,230,000,000 years ago.

Since then the earth has not been cooling down, but has kept its surface temperature surprisingly uniform, though with minor variations, including several ice ages. The carbon and limestone in the earliest rocks suggest lowly plant life in the waters from the very beginning of known geological history, and the Pre-Cambrian geologist is inclined to be a uniformitarian, and to ask the astronomer if the first quarter of the world's history was really so wild and turbulent as he describes it, when the later three-quarters were so temperate and uniform.

May not the earth have been built up of cold particles such as now reach us by the million from space, and may it not have escaped entirely the white hot stage of the nebular theory? Is it not possible that the hot gases cooled rapidly into innumerable solid particles which later came together to make the earth? The tiny scattered asteroids and meteorites suggest some such process; and this would provide

the cold earth which the Pre-Cambrian geologist requires.

If the astronomers cannot provide a cold process of world building, they must allow the geologist a much longer time than 2,000,000,000 years to condense the hot cloud of gas into a solid world with continents and basins cool enough for the Grenville sea with its algæ.

A. P. COLEMAN.

Royal Ontario Museum,
Toronto.

[1] Ages of Some Canadian Pegmatites, *Contribs. to Can. Mineralogy*, Univ., Toronto, 1924.
[2] Radioactive Minerals as Geological Age Indicators, *American Journal of Science*, No. 50, p. 127, etc.

Recombination of Electrons and Positive Ions in the Upper Atmosphere.

A METHOD of obtaining the recombination coefficient of the electrons and ions in the upper atmosphere can be arrived at by the use of some recent radio telegraphic observations. The method depends essentially upon the measurement by radio methods of the maximum density of electrons in the layer at various times of the night after the ionising agent, the sun's ultra-violet light, has been removed.

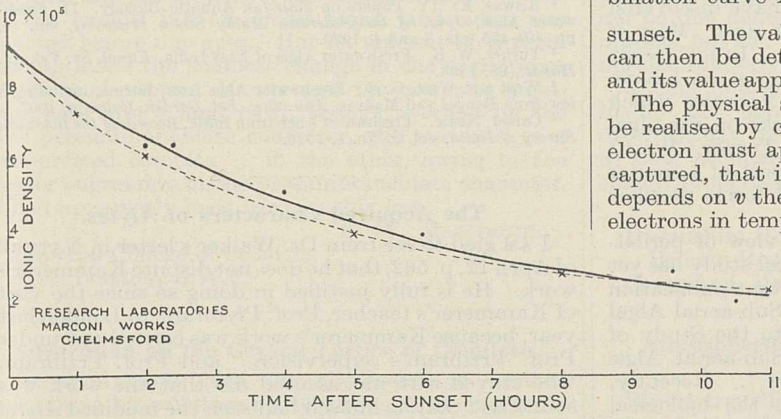

FIG. 1.—Full line, observed curve; broken line, recombination curve.

A ray of frequency ν sent out by a radio transmitter at an angle of elevation θ will not be bent back to the earth again unless there are sufficient free electrons in the layer, and the relation determining the number of electrons N required is

$$\cos\theta = \frac{R+h}{R}\sqrt{1-\frac{Ne^2c^2}{\pi m\nu^2}}.$$

N is electron density; when h, the height of the layer is small compared with R, the earth's radius, this is approximately

$$\frac{Ne^2c^2}{\pi m} = \sin^2\theta + 2x,$$

where $x = h/R$, and where e, m, and c have their usual significance.

In general, if such a frequency ν is chosen that $\frac{N_{\max.}e^2c^2}{\pi m\nu^2} = \delta < 1$, then those rays for which $\sin^2\theta > \delta - 2x$ will not be returned to earth.

The method, then, consists in determining the value of $\theta_{\max.}$; that is, the greatest angle at which rays are reflected to earth. For this purpose an accurate determination of θ is necessary. The working of the facsimile device between New York and England on a wave-length of 22 m. has provided an opportunity of accurate measurement of these ray angles.

If a single short impulse $< \frac{1}{1000}$ sec. duration is sent out by the transmitter, it is generally reproduced as 2, 3, 4, or even 5 separate images corresponding to various rays of elevation at the receiving end θ_1, θ_2, θ_3, θ_4, θ_5, etc. From the speed of the receiving drum it is easy to calculate the time intervals T_{1n} between these signals and using the relation

$$T_{1n} = \frac{d}{c}\left(\frac{1}{\cos\theta_n} - \frac{1}{\cos\theta_1}\right) = \frac{d}{c}\left(\frac{1}{\cos\theta_n} - 1\right),$$

where d is the distance of transmitter from receiver (assuming $\cos\theta_1 = 1$), to calculate accurately the value of θ_n.

Values of θ up to 35° have been obtained and the value of $\theta_{\max.}$ was found to decrease throughout the night. Using this material, the accompanying curve (Fig. 1) representing $N_{\max.}$ as a function of the time after sunset has been secured. It is confirmed less accurately by transmission results which give the shortest wave that will return to earth at any given time of the night, and represents therefore the variation of N throughout the night.

The dotted line represents the theoretical recombination curve $N = \frac{N_0}{1+N_0\alpha t}$ where t is the time after sunset. The value of α, the recombination coefficient, can then be determined from the best fitting curve, and its value appears to be close to $8{\cdot}75 \times 10^{-11}$ cm.^{2}/sec.

The physical significance of this quantity can best be realised by calculating the distance to which the electron must approach a positive ion in order to be captured, that is, the 'recombination radius'. This depends on v the electron velocity. If we assume the electrons in temperature equilibrium at 300° absolute, $v = 1{\cdot}1 \times 10^7$ cm./sec. and σ the recombination radius is $1{\cdot}4 \times 10^{-9}$ cm. If the actual value of v were v_0 and not $1{\cdot}1 \times 10^7$, the value of α would be $1{\cdot}4 \times 10^{-9}\sqrt{\frac{1{\cdot}1 \times 10^7}{v_0}}$ cm., $\sigma = 1{\cdot}4 \times 10^{-9}/\sqrt{28V}$, where V is the voltage equivalent of the electrons of velocity v. This seems a reasonable value in view of the theoretical work of Kramers, Eddington, Milne, and others.[1]

Unfortunately, only recombination radii for stripped nuclei can be obtained theoretically from Kramers' formulæ, namely,

$$\sigma^2 = \frac{10^{-20}}{V}\frac{Z^4}{r^3(9{\cdot}5z^2/r^2 + 0{\cdot}7V)},$$

where Z is the atomic number, V is the equivalent voltage of the recombining electron, and r the number of the quantum state in which the electron is captured. No reasonable adjustment of V can make this formula agree for the ionised hydrogen atom, and the least value of Z required is 7, $r = 1$, in which case σ is $1{\cdot}22 \times 10^{-9}$.

The pressure at the measured 'equivalent height' at which the observed recombination occurs, namely, 340 km., is entirely unknown, but certain results, independent of this pressure, may be given.

The mean free life of an electron between ionisation and capture is approximately five hours. Assuming $v = 1{\cdot}1 \times 10^7$, then the total distance travelled in this time is 2×10^6 km. although its final distance from the origin is much less, of course, depending on the number of collisions made with other molecules.

During this period it makes about 120 collisions with ionised atoms within a radius of $2{\cdot}74 \times 10^8$ cm. (the assumed average radius of the atoms of the atmo-

sphere). These last figures depend on the assumed value of v.

T. L. ECKERSLEY.
Research Laboratories,
Marconi's Wireless Telegraph Co., Ltd.,
Chelmsford, Essex.

[1] A summary of the work on recombination is given by Seeliger, "Die Wiedervereinigung von positiven Ionen." *Phys. Zeits.*, **30**, 1929.

Freshwater Biological Research in the Indian Empire.

I HAVE read with deep interest the article by Prof. F. E. Fritsch under the title of "Research in Freshwater Biology and the Functions of a Freshwater Biological Station", published in NATURE of Feb. 15 (vol. 125, p. 241). Work in this line is imperative in the Indian Empire. Algological research in the Indian Empire is still in its infancy. Investigation into the algal flora of this country is not only valuable for its purely scientific interest but also from a practical point of view, as hinted in Prof. Fritsch's article. So far as my experience goes, this land is very rich in algal vegetation. From a few bottles of algæ collected from the Loktak Lake, Manipur, Assam, by the late Dr. N. Annandale, Dr. Brühl [1] and I have discovered as many as forty-three new species of algæ. Most of them were found from a small bottle. In my recent work [2] on freshwater algæ of Malayan waters, I have described four species and five new varieties which appear new to science. Previous works on the algal flora of this country such as those of Turner,[3] West,[4] and N. Carter [5] also confirm the prospect of a similar finding of interesting new plants and forms peculiar to the Indian soil and climate.

Not much work from the point of view of periodicity, quantitative analysis or ecological study has yet been done here except Fritsch's important publication on "A General Consideration of the Sub-aerial Algal Flora of Ceylon and a Contribution to the Study of Tropical Algal Ecology. Part 1. Sub-aerial Algæ and Algæ of the Inland Freshwater". Recently, however, I have taken up work on the biological investigation of the filter-beds of Calcutta—in collaboration with Rai Bahadur Dr. G. C. Chatterjee (protozoologist), Dr. T. K. Ghose (chemist), and Mr. K. N. Das (zoologist). The work, so far as results obtained up to now show, is of immense importance from a biological point of view as suggested by Prof. Fritsch. It has been observed that there is a regular rotation in the growth of algal vegetation in the filter-beds, which is invariably associated with animal organisms, such as Protozoa, sponges, worms, larvæ of insects and molluscs sp. Growth of green algæ predominates over the blue-green ones, and diatoms are found either as pure formation or as epiphytes. *Synedra affinis* var. *fasciculata* is the most common species present in all the filter-beds. Of the algæ, *Clathrocystis aeruginosa*, *Volvox globator*, *Cladophora crispata* var. *genuina*, *Zygnema* sp., *Tribonema bombycinum*, *Gloeotrichia natans*, *Hydrodictyon* sp. often grow either as pure or mixed formation or by rotation, one appearing after the other. These grow frequently in such huge masses that they have to be scraped off and carried away in cartloads.

The life-histories of these algæ are intimately connected with and thus controlled by the physical, chemical, and climatic conditions in and around the filter-beds. Detailed algological and chemical analyses of this water of the filter-beds are being carried on, and the correlation of all the factors will, it is expected, throw much light on the aquatic biology of the filter-beds. Experiments for the control of the different species have been undertaken with the view of keeping the filter-beds to a certain extent free from the crowded growth of algal vegetation, as the growth of the algæ sometimes reaches the point when it chokes up the action of filtration. Then the masses of algal vegetation, by dislodging from the bottom, cause fissures in the floors of the filter-beds which become the abode of animal organisms and thus the filter-beds are rendered defective. Algal contents of the oysters of the Malay Peninsula are also being investigated.

There is, therefore, a vast field for research work in various avenues for the algologists in India. There is no doubt that biological investigations of fresh and marine waters of this country are of greatest importance from the points of view of pisciculture and sanitation; for fish, one of the important foods for human beings, are directly or indirectly dependent on algal vegetation, and some lower members of algæ also by assimilation of organic matters for their growth expedite the self-purificatory action of the water.

K. BISWAS.
The Herbarium,
Royal Botanic Garden,
Calcutta, Mar. 20.

[1] Brühl, P., and Biswas, K. Algæ of Loktak Lake, *Memoirs of the Asiatic Society of Bengal*, No. 5, 1926.
[2] Biswas, K. IV. Papers on Malayan Aquatic Biology. 11. Freshwater Algæ, *Jour. of the Federated Malay States Museums*, vol. 14, pp. 404-435, pts. 3 and 4, 1929.
[3] Turner, W. B. Freshwater Algæ of East India, *Kungl. Sv. Vet. Ak. Handl.*, 25, 1893.
[4] West and West, G. S. Freshwater Algæ from Burma, including a few from Bengal and Madras, *Ann. Roy. Bot. Garden, Calcutta*, 1907.
[5] Carter, Nellie. Freshwater Algæ from India, *Records of the Botanical Survey of India*, vol. 9, No. 4, 1926.

The Acquired Characters of *Alytes*.

I AM glad to see from Dr. Walker's letter in NATURE of April 12, p. 562, that he does not dispute Kammerer's work. He is fully justified in doing so since the visit of Kammerer's teacher, Prof. Przibram, to London last year, because Kammerer's work was carried out under Prof. Przibram's supervision: and Prof. Przibram, who stayed with me, assured me that the work was sound and that he himself had seen the modified *Alytes* when alive.

But Dr. Walker asserts that the work, if fully confirmed, would afford no proof of the inheritance of acquired characters because the modified *Alytes*, if replaced in the normal conditions, would in all probability revert to the type form. This assertion implies a confusion of thought in Dr. Walker's mind, which is shared apparently by many others.

It is no explanation of Kammerer's results to say that they are due to "the presence in the germplasm of potentialities to respond in a definite manner to changes in the environment". Undoubtedly this power resides not only in *Alytes*, but also in greater or less degree in all organisms—otherwise there would be no possibility of evolution. The question at issue is whether the exercise of this power in one generation affects the possibility of its exercise in subsequent generations—and Kammerer's experiments not only on *Alytes* but also on *Salamandra* prove in the clearest manner that this is so. Dr. Walker apparently expects that if an animal, moved from environment A to environment B, responds by a change in growth and structure, this change should persist without alteration when it is moved back from environment B to environment A. What we might reasonably expect, and what as a matter of fact we find, is that when the animal is kept for several generations in environment B, the response is intensified and appears earlier in development—in a word, that it becomes more *engrained* in the hereditary complex, and that when it is moved from environment B to environment A,

there is a *lag* in the re-assumption of ancestral characters.

It required, according to Kammerer, no less than six generations in the modified environment to awaken in *Alytes* the ancestral potency to produce the nuptial pad; and the offspring of *Salamandra maculosa*, which had been reared in a yellow environment, became yellower for the first eighteen months of their lives in spite of the fact that they were reared in a black environment. Similar results were obtained by Dürkhen with the pupæ of white butterflies, and the cumulative effect of succeeding generations in intensifying acquired immunity has been beautifully shown by Metalnikoff in the caterpillars of the bees-wax moth *Galleria*.

In conclusion, let me describe a series of experiments carried out in my own laboratory at the Imperial College of Science under my supervision by my former colleague Dr. (now Prof.) Hogben. We had specimens of two very similar newts living in our tanks, namely, the axolotl (*Siredon pisciformis*) and the mud-puppy (*Necturus lateralis*). Both normally live all their lives in water and retain external gills and open gill slits through life. Both were fed in the same way with thyroid, and the miracle of the change in a few weeks of the axolotl into a small black land newt was enacted before our eyes. But no amount of thyroid feeding made the smallest change in the appearance of the mud-puppy. In one case the power to metamorphose into a land newt, though overlaid by the new perennibranchiate character, still survived as a 'suppressed complex'; in the other, owing to the deeper engraining of the perennibranchiate character, it had apparently been irretrievably lost.

E. W. MACBRIDE.

Imperial College of Science,
London, S.W.7.

Adsorption on the Crystal Lattice of Cellulose.

INVESTIGATIONS into the adsorption of various substances by cellulose in the presence of dispersive mediums such as sulphuric acid, zinc chloride solution, etc., have resulted in some very interesting observations in my laboratory during the past two years.

The more important of these will be published in due course, but meanwhile the nature of the blue, violet, and red iodine adsorptions from a solution of iodine in potassium iodide in the presence of the dispersive solutions is of considerable theoretical interest to those who are working either with cellulose or similar colloidal substances.

1. A pencil of light, passing through a natural fibre of cellulose (a flat spruce tracheid, for example), the latter being deeply stained with iodine by the methods indicated above but still translucent enough to pass light, is completely polarised by absorption.

2. Two fibres stained with iodine in this way, when crossed at right angles, behave like tourmaline plates, giving total absorption of the light at the area of crossing.

3. Microscopical analysis of this phenomenon proves that the polarisation of the light is caused by ultramicroscopic crystalline particles of iodine oriented on the crystal lattice of the cellulose either as an isomorphic or an isogonic overgrowth, or intergrowth.

4. It is presumed from the optical properties of the smallest crystals of iodine observed under the microscope that these crystalline particles of iodine are rhombic prisms.

5. The iodine penetrates into the interior of the cell-walls, but the concentration is greatest on the surface, where it tends to develop into an actual microcrystalline overgrowth of iodine crystals.

In other experiments definitely oriented crystal overgrowths of calcium carbonate and barium sulphate (both rhombic) have been produced on natural fibres of cellulose. In the case of natural dendritic growths (arising from a particle of bronze or copper) in paper, the actively spreading material during the fern-like growth is copper sulphide which is also rhombic in structure.

With regard to the blue and red absorptions of iodine on cellulose, which are still under investigation, the following points may be noted:

1. It is expected that some further light will be thrown on the problem of the formation of similar coloured adsorption compounds of iodine with other substances, now a subject of considerable interest in colloidal chemistry.

2. This type of adsorption of one crystal lattice upon a second may possibly take place in the dyeing of cellulose. The iodine-stained fibres, like those dyed with cotton and basic dyes, are strongly dichroic. In the latter case dichroism is the only evidence of orientation, but in the case of iodine we have both strong dichroism and complete absorption of one ray giving polarisation of transmitted light. It appears probable that the dichroism of the dyed fibres may not be due merely to the orientation of the cellulose micellæ, but also to the crystalline structure of the dye micellæ similarly oriented.

3. The iodo-sulphates of quinine (artificial tourmaline or 'herapathite') which are also strongly dichroic may be isomorphous crystalline compounds, as their peculiar optical properties are clearly due to similar properties in the iodine itself.

JAMES STRACHAN.

Devonshire House,
Pelham Road,
Gravesend, Mar. 3.

Atmospheric Light Columns from Artificial Lights.

WHEN travelling by tram, I have often seen the light of street lamps drawn out into beams perpendicular to the direction of streaks left upon the window glass. Effective fibres of the cleaners' cloth are sensibly parallel, and though I had mentally noted that the beams were due to diffraction, it had not hitherto seemed worth while publishing the observation. I would suggest, however, that it provides a simple analogue for the atmospheric light columns mentioned by Dr. Currie in NATURE of April 5.

There can be no doubt that the vertical atmospheric beams are due to horizontal particles, which need not be laminar as suggested by Dr. Whipple. Some readers may find difficulty in accepting a horizontal orientation of falling particles, and it is therefore of interest to recall the observations of Dr. John S. Owens (*Brit. Assoc. Rep.*, p. 611; 1913) upon the deposition of silt and sand in water. He found that when bodies of different shape (discs, rectangular plates, or rods) were allowed to settle in water, they settled in every case in the position offering the greatest resistance to movement.

Construction of a model to produce light columns presents no difficulty in principle; all that is required is a suspension of lamellar or acicular particles within a transparent chamber having plane parallel sides. I believe I have obtained an indication of the effect with crude apparatus, but a successful result could be obtained only under rigorous conditions in which the effects of convection and tremor can be eliminated.

The apparently contradictory orientation of both lamellar and acicular particles when suspended in a fluid at rest, and when giving rise to the phenomenon

which I called '*swirl opalescence*' (NATURE, **123**, 491; 1929) are consistent with the principle of least action. I should like to mention that I accept Dr. A. S. C. Lawrence's suggestion (private communication) of the term '*stream scintillation*' in place of swirl opalescence.

HUGH NICOL.

Rothamsted Experimental Station,
Harpenden, Herts, April 5.

The New Planet.

DANS le numéro de NATURE du 12 avril, p. 577, le rédacteur de la note "The New Planet" suppose gratuitement que j'ai commis une erreur de raisonnement dans le calcul du diamètre photométrique de la nouvelle planète. L'inexactitude de cette supposition se trouve démontrée par ma Note, présentée à l'Académie des Sciences de Paris dans sa séance du lundi 7 avril, intitulée : "Sur le calcul du diamètre photométrique du corps céleste de l'Observatoire Lowell" (*Comptes rendus*, t. 190, p. 857; 1930), où se trouve précisément reproduite la formule qui m'a servi :

$$\log \frac{D}{D'} = \frac{1}{5}(m' - m) - \log \frac{r'\Delta'}{r\Delta},$$

et aussi par ce fait que le calcul basé sur le carré de la distance r' au lieu du carré du produit $r'\Delta'$, ne donnerait pas 1500 km. avec les constantes que j'ai indiquées ($D = 53{,}000$ km., $m' = 15{\cdot}0$, $m = 7{\cdot}5$, $r' = \Delta' = 45$, $r = 30$, $\Delta = 29$, $A = 0{\cdot}6$, $A' = 0{\cdot}15$), mais 5000 km. En réalité, il s'était glissé dans *l'Information Rapide*, et ma première Note à l'Académie qui en est la reproduction, une simple erreur numérique dont j'ai publié aussitôt une rectification.

F. BALDET.

Observatoire de Meudon,
Avril 12.

ALL that was stated positively in the note on M. Baldet's diameter of the new planet was that his conclusion that its diameter was only 1500 km. if its albedo was taken as 0·15 was erroneous. His present note is in full accord with that statement, since he now gives, in *Comptes rendus* for April 7, a diameter of 2500 km., taking the albedo equal to that of Neptune; that would give 5000 km. with an albedo $\frac{1}{4}$ that of Neptune.

The note in NATURE went on to say (correctly) that some people had made the mistake of making the light vary as the inverse square of the distance, instead of the inverse fourth power. M. Baldet's letter makes it quite clear that he did not fall into this error. Needless to say, the note was written and published before any correction of M. Baldet's original statement had been received.

THE WRITER OF THE NOTE.

Influence of Chemical Colloidisation on the Anomalous Diamagnetism of Bismuth and Antimony.

IT is a well-known fact that antimony and bismuth possess a high diamagnetism in the solid massive state, the specific susceptibilities being $0{\cdot}78 \times 10^{-6}$ and $1{\cdot}17 \times 10^{-6}$ respectively at 30° C. according to my experiments. In a communication published in NATURE of Nov. 16, 1929, p. 762, I reported the results of the influence of particle size on the anomalous diamagnetism of antimony, its value falling on mechanical colloidalisation. Further experiments on chemical colloids of bismuth and antimony show a still more striking decrease.

Colloidal antimony was prepared by reducing a solution of potassium antimonate by sodium hydrosulphide. This was centrifuged and the fine particles further purified in very dilute hydrochloric acid and carbon disulphide to remove traces of iron and sulphur. The specific diamagnetic susceptibility obtained was $0{\cdot}31 \times 10^{-6}$ with a particle size of about 100 $\mu\mu$, the particles themselves appearing as clusters of small particles.

In the case of bismuth, the colloid was prepared by reducing bismuth tartrate by stannous chloride in alkaline lye and centrifuging. The purified substance gave a diamagnetic susceptibility of $0{\cdot}25 \times 10^{-6}$. (See also Honda and Owen, *Ann. der Phys.*, **37**, 657; 1919; where Kahlbaum's colloidal bismuth is reported to give $0{\cdot}47 \times 10^{-6}$, whereas in the massive state it is $1{\cdot}4 \times 10^{-6}$.)

These results seem to indicate that the high diamagnetism of these elements and that of graphite (Sir C. V. Raman; see NATURE, June 22, 1929, p. 945) is a crystalline property and not atomic as diamagnetism is generally understood to be.

V. I. VAIDYANATHAN.

Annamalai University,
Chidambaram, South India, Mar. 8.

Leaf-Curl in Cotton.

IN an article entitled "Cotton in Africa" (NATURE, Feb. 22, 1930, pp. 291-292), referring to cotton in the Sudan, it is stated that "Recently the disease known as leaf-curl has been attacking the crops in this locality, and there is evidence that the jassid insect is responsible for spreading the contagion. The Corporation is now considering the desirability of breeding jassid-resistant strains in the Sudan."

Working in the Gezira area, which is by far the most important long-staple cotton-producing locality in the Sudan, I have recently proved that leaf-curl of cotton (or, as it should preferably be called, leaf-crinkle) is transmitted mainly, if not entirely, by an at present undetermined species of Aleurodidæ (Whiteflies). A preliminary paper on the subject has been submitted for publication.

T. W. KIRKPATRICK.

Wellcome Tropical Research Laboratories,
Gezira Branch Laboratory,
Wad Medani, Sudan.

Mounting Media for Microscopic Work.

ALTHOUGH, as Mr. Wilfrid Marshall points out in NATURE of April 12, there appears to be no theoretical advantage in using a mountant containing dried Canada balsam and α-bromonaphthalene, in practice the mixture has the valuable property of high viscosity. The use of a medium of high viscosity enables fresh mounts to be photomicrographed at high magnification, using the microscope in a horizontal position; in fact, we now find it to be an advantage to use twice the stipulated quantity of dried Canada balsam in order to make the mountant as viscous as possible, so that film sections may be photomicrographed within a few minutes of being cut.

E. E. JELLEY.

Research Laboratory,
Kodak, Limited, Wealdstone, Middlesex.

An Anthropological Congress.

I HAVE to-day received from the Institut International d'Anthropologie in Paris a copy, dated Feb. 15, and marked 'urgent', of the circular of invitation to the two Anthropological Congresses to be held concurrently in Portugal in September 1930, of which I was able to give some particulars in my letter of Mar. 15, published in NATURE of Mar. 29.

JOHN L. MYRES.

Royal Anthropological Institute,
London, W.C.1, April 16.

Some Solar Eclipse Expeditions of 1930 and 1932.

By Prof. F. J. M. STRATTON.

THE two total solar eclipses of this year are not attracting organised expeditions from Great Britain. The first one, on April 28, was annular over most of its path, though it was total along a narrow belt not more than half a mile wide from just north of San Francisco across Nevada and Idaho to a point north of Virginia City in Montana. The uncertainty in the position of the belt was estimated at a quarter of a mile, and totality was nowhere longer than 1·5 sec. An eclipse of this kind may be valuable for the investigation of the flash spectrum at different levels, and observing parties went not only from the nearby observatories of Mt. Hamilton and Mt. Wilson, but also from the Allegheny Observatory. It is to be hoped that answers have been obtained to some of the problems which, with the aid of clouds, have been eluding eclipse observers for the past few years.

The second total eclipse of this year, that of

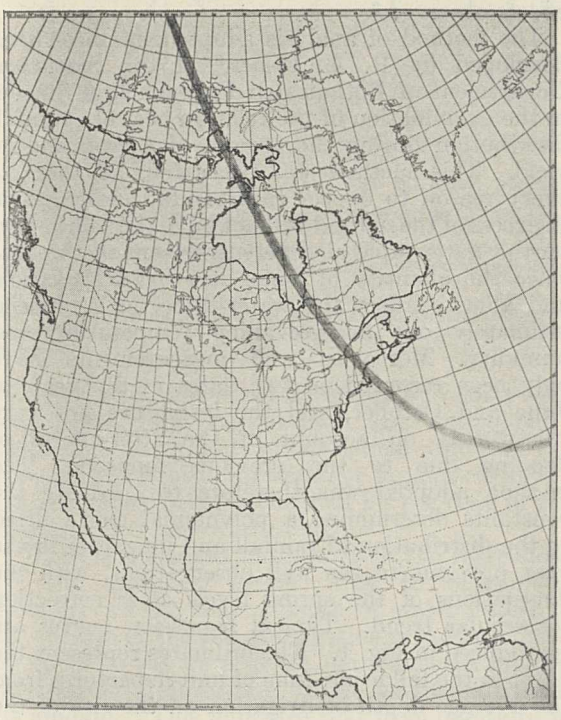

FIG. 1.

Oct. 21–22, is visible from the small island of Niuafou in the Tonga Islands and near sunset in Chile and Patagonia. Totality lasts 2 minutes. The New Zealand government and the United States Naval Observatory are sending expeditions to Niuafou. A recent volcanic outburst which partially destroyed the island will add to the difficulties which must face these parties in arranging their eclipse camps, but may also appreciably add to the interest of the expeditions. Dr. C. E. Adams is going as leader of the New Zealand expedition and Prof. S. A. Mitchell as leader of the American party.

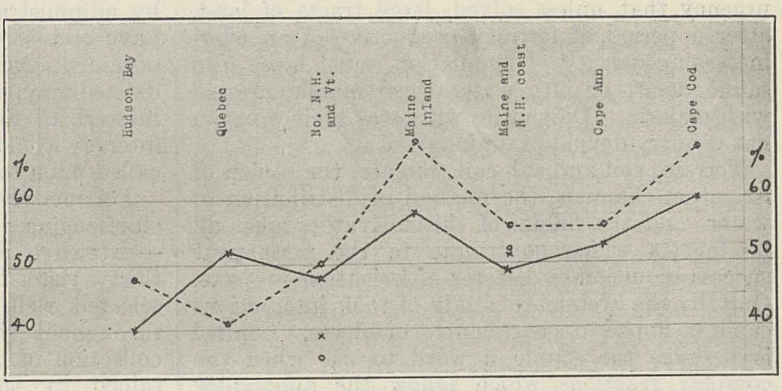

FIG. 2.

The next eclipse which is likely to be widely observed is that of Aug. 31, 1932, visible in Canada and in the Eastern United States (Fig. 1). The next ordinary General Assembly of the International Astronomical Union will be held about a week later at some nearby centre in the United States, so that a number of astronomers from other continents may be expected to observe this eclipse alongside of their Canadian and American colleagues.

Five years ago Prof. Todd began collecting weather observations along the track of this eclipse, and in 1929 Prof. Slocum took over from him the task of collecting and collating the data. He has published the results of the observations to date in *Popular Astronomy* for April, and with his permission some of his data are reproduced here. As will be seen from Fig. 2, the chances of success are about one-half at most stations between Hudson Bay and the coast of Maine. Only the intermediate stations are considered by Prof. Slocum, who suggests that the best place for a camp is some distance back from the Maine coast, perhaps between East Baldwin and Fryeburg.

South of the St. Lawrence River in Canada, as also in the States, the central line is readily accessible by rail, and it should be easy to spread a number of observing parties along the central line. At Yamachiche, on the St. Lawrence River, there is a large Marconi wireless station. At Drummondville, Sherbrooke, and Magog good accommodation would be available, but there should be none of the difficulties that frequently await eclipse expeditions in out-of-the-way parts of the world, and a well-distributed set of parties may hope to secure a reasonable proportion of successful observations.

It should be added that totality lasts about 100 seconds, that the width of the belt of totality is about 80 miles, and that its south-western edge runs from Montreal to the coast of Massachusetts midway between Salem and Gloucester.

Problems of Irrigation.

By Prof. B. H. WILSDON.

THE introduction of irrigation in an arid country, along with its obvious blessings, brings in its train diverse problems, as do most other of man's disturbances of Nature's equilibrium. The consequences may give rise to problems of such urgency that, unless solved, large tracts of land, after a period of fertility productive of an ever-increasing density of population, must lapse into saline desert or into waterlogged marsh infested with malaria. Difficulties will be at their worst in flat country devoid of drainage.

Terrain, soil and sub-soil, climate, the design of irrigation channels, the method of distribution of water, and the habits of the cultivator, must all be factors which contribute to the permanent success or ultimate disaster of irrigation projects. Only by the systematic study of their interactions can it be hoped to secure control of effects. Control is perhaps too strong a word to use when the complex reactions which follow the apparently simple engineering feat of digging a canal for irrigation are properly considered, but for the possibility of disaster we have object lessons in the ruined irrigation systems of Mesopotamia and the Punjab, which must once have supported flourishing civilisations.

In the Punjab an average flow throughout the year of about 25,000 cubic feet of water a second is maintained by irrigation works by which some $10\frac{1}{2}$ million acres of crops are matured in land previously desert or precariously cultivated. These figures omit the great areas which are now coming into cultivation as a result of the new irrigation works on the Sutlej, and greater areas, which will be irrigable when the Sukkur barrage on the Indus is completed.

Of the $10\frac{1}{2}$ million acres irrigated in the Punjab, the area threatened with waterlogging has been estimated at $3\frac{3}{4}$ million acres.[1]

The new areas now being brought under irrigation are probably more liable to damage than those in the Punjab, since, in general, soils become heavier and the fall of the land flatter as we proceed south.

The need for research has been recognised, but not too soon. As a matter of Imperial interest, the question has been under examination for some time by a special committee appointed by the Committee for Civil Research. The report of this body will be awaited with interest. In the Punjab, the ominous rise of the water-table in many irrigated tracts, the abandonment of an increasing acreage of once fertile land through actual waterlogging and the spread of saline soil, could not be longer ignored. Some preliminary steps have already been taken in an attack by scientific methods upon the analysis of the factors, and in attempts at control, by the formation in the Punjab under the Irrigation Department of a research organisation. A laboratory equipped for the study of the hydrodynamic and physico-chemical problems which await solution is nearing completion, and a staff of computers for statistical investigations has been at work for some time. Already some light has been thrown on the gravity of the problem, and indications of the most feasible methods of control by administrative methods or engineering works have been secured. A brief account of the results obtained and the problems now more clearly defined may, it is hoped, reveal subjects of scientific interest to workers in many fields whose active interest would be of valuable assistance to those called upon to face the situation.

Fortunately, due to the foresight of a former chief engineer of the Punjab—Sir Thomas Higham—extensive records have been kept for nearly thirty years of the depth of the water-table in selected wells scattered more or less uniformly throughout the irrigated tracts. This valuable collection of data, with records of rainfall maintained by the Irrigation Department at sub-divisional stations, and the recorded volume of irrigation water admitted to canal distributaries, enables statistical estimates to be made, not only of the present and future rate of rise of a water-table but also of the relative responsibility of rainfall, drainage, and the irrigation load for the effects observed.[2]

The method of analysis adopted has been that developed by R. A. Fisher[3] of the Statistical Department of Rothamsted Experimental Station in the examination of the relation between rainfall distribution during the growth of a crop and its yield. This method was necessary, as there is every reason to expect that rainfall or irrigation in excess of the normal will not have the same effect on the water-table at different seasons of the year since the quantity of water lost by evaporation, and able to affect the water-table, must depend intimately on the prevailing temperature and humidity. Moreover, well measurements have only been recorded on two dates in the year, in June and October, and the latter are not very trustworthy on account of the after-effects of flooding due to the previous monsoon. The method adopted was therefore to correlate the constants determining a polynomial curve fitted to the distribution of rainfall and irrigation in the year previous to the well observations, with the fluctuations of the spring levels after correction for secular trend. Typical regression curves are reproduced in Fig. 1. The ordinates represent the effect in the following June of unit departures from the average depth of irrigation on the rise of the water-table.

Such curves represent the result of heavy computations. More than three hundred individual well records are included, each of which is suitably weighted for the area of which it is taken as representative. Secular change was eliminated from the record of well fluctuations by fitting an exponential curve, departures from which were

correlated with the rainfall and irrigation distribution.

The available record varies from 20 to 27 years in the cases examined. The unit of time was taken as five days, for each of which it was necessary to compute the rainfall from about fifty rain-gauge

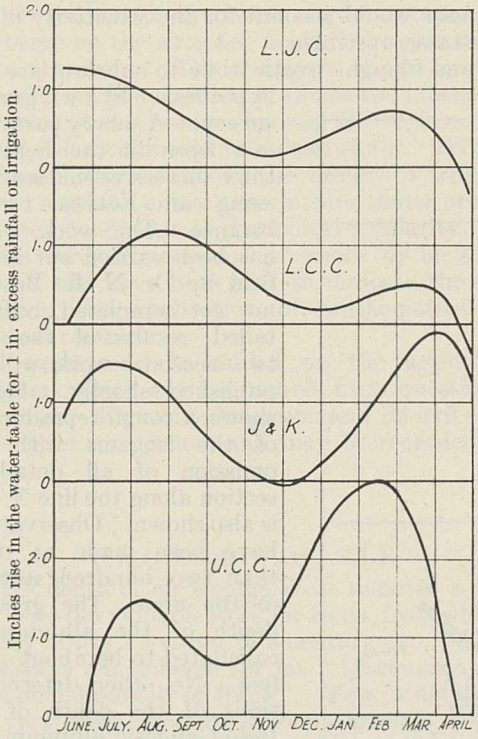

FIG. 1.—Typical regression curves showing the effect of rainfall or irrigation on the rate of rise of the water-table.

L.J.C.—Lower Jhelum Canal. Area, 2096 sq. miles; recorded wells, 80; perennial irrigation.
L.C.C.—Lower Chenab Canal (Upper); 2030 sq. miles; recorded wells, 54; perennial irrigation.
J. & K.—Jaurian and Kasoki distributaries. Area, 65·2 sq. miles; recorded wells, 6; the water-table is high and a considerable proportion is irrigated by wells.
U.C.C.—Upper Chenab Canal. Area, 2486 sq. miles; recorded wells, 83; the water-table is high throughout the area and a large proportion receives irrigation only in the summer season. A large area of rice is grown.

stations and the records of many canal distributaries. The correlations are undoubtedly significant according to statistical criteria, the percentage of the total variance accounted for by the regression being more than 60 per cent in the mean for the cases illustrated.

There is a marked uniformity in the regressions for the monsoon period, July to September. Roughly we see that a depth of water added to the surface of the soil as irrigation or rain produces an effect on the water-table, detectable six months afterwards, of from one to one and a half times its amount. This indicates that from one-third to one-half of the water must reach the water-table from the surface, since the porosity of the soil may be assumed to lie between 30 and 40 per cent. The effects of irrigation during the winter months are more diverse, as might be expected. There is, in addition to the monsoon maximum, an obvious tendency to attain another maximum effect during February and March. This is most marked in the Upper Chenab Canal, which differs very considerably in its agricultural regime from the others.

The winter 'hump' in the regression curve has afforded an instructive insight into agricultural practice, and has been traced very conclusively to wasteful irrigation. The most important application of the results has been in guiding administrative action in insistence on economy. It is obvious from the curves that great effects are possible through economy, or avoidance of waste, during the monsoon, and, on certain canals, during February and March. The total closing of certain canals for periods during the monsoon has been tried and would already seem to have produced promising results without undue interference with agriculture. The effects in future years of the policy now adopted will be awaited with great interest.

Fig. 2 shows the mean observed annual rates of rise of the water-table, averaged from 54 separate well records over a tract of about 2500 square miles in the Lower Chenab Canal. The exponential correction for trend is also shown, as well as the fluctuations calculated by means of the derived regression equation from the recorded irrigation and rainfall. The fit of the observed and calculated fluctuations in the rate of rise is remarkable.

If we assume that the rise of the water-table, falling off exponentially as it appears to do, will continue unchecked, it is calculated that the water-table as a whole will rise another 13 feet above its level in 1927. This must result in a very considerable portion of the area becoming waterlogged. By a similar calculation for the Lower

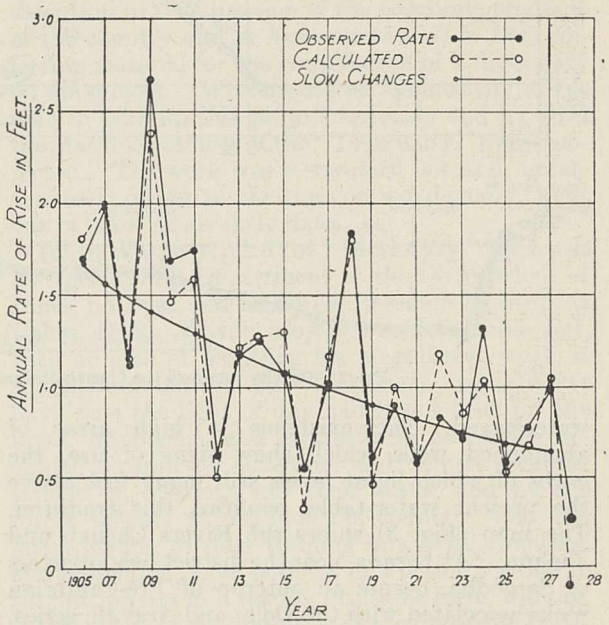

FIG. 2.—Lower Chenab Canal. Calculated and observed rates of rise of the water-table.

Jhelum Canal, in which the water-table has exhibited a remarkable rate of rise, the corresponding final equilibrium is calculated to be 56 feet above its present level.

A second line of investigation, on which work is

still in progress, has been directed to the elucidation of the causes for such exceptionally rapid rises of the water-table as have been recorded in the Lower Jhelum Canal since the introduction of irrigation. Much of the area is easily commanded by inundation canals, but the higher areas are served by high level channels from the head works at Rasul and Mangla. Tradition states that the tract was once irrigated even in the higher areas, but that "God became angry" and the land

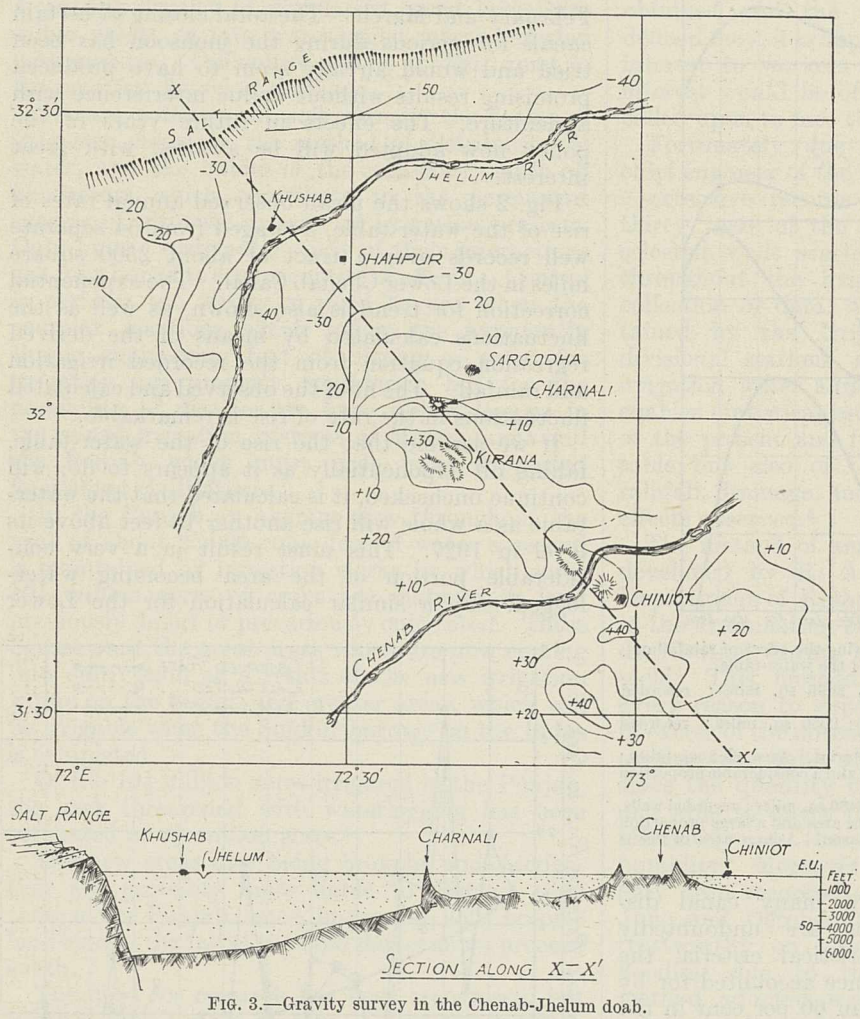

FIG. 3.—Gravity survey in the Chenab-Jhelum doab.

waterlogged. The existence in high areas of abandoned wells which show signs of use, the curbs of which lie at levels still many feet above the present water-table, confirms this tradition. The map (Fig. 3) shows the Rivers Chenab and Jhelum. At Kirana, near the district headquarters of Sargodha, occurs an outcrop of Pre-Cambrian rocks associated with the Delhi and Aravalli series. Similar rocks are found at Chiniot where the Chenab passes through a gorge, and at Shahkot and Sangla farther south. To the north-west lies the Salt Range where rocks ranging from Tertiaries to Lower Carboniferous lie unconformably over the Aravalli Cambrians. It is a remarkable fact that the principal incidence of waterlogging and the areas in which the rise of the water-table has been most rapid, lie to the north-east of a line roughly joining these outcrops with the Dehli ridge. This suggests the possibility that the deep Indo-Gangetic alluvium is traversed by a submerged ridge along this line which might act as a weir to head up the subsoil drainage. Such a rock mass would account for the sensitivity of the water-table upstream.

It was thought worth while to substantiate this hypothesis by a gravity survey. A survey party has now been in the field for three successive cold seasons, using an Eötvös torsion balance. The work, which has been carried out in the field by Dr. N. K. Bose, is not yet completed, but detailed results of the first two seasons' work will be published shortly. Fig. 3 shows a rough reproduction of the isogams with the omission of all detail; a section along the line X – X′ is also shown. Observations have been made at more than two hundred stations in the area. The greatest depth of the alluvium is calculated to be about 5000 feet. No other determinations of the depth of the Indo-Gangetic alluvium are available for comparison; rock has never been reached by boring in the alluvium proper. Extension of the results now obtained would probably be secured, at considerably less trouble than is entailed in work with the torsion balance, by the recently developed methods of seismic sounding. It is to be hoped that this will prove possible in the future.

It is clear that the comparatively shallow sub-soils found to the south-east of the tract illustrated must affect considerably its drainage, but no quantitative estimate is yet possible. The rapid rise of the subsoil rock at the base of the Salt Range is a subject of considerable geological interest, but no stratigraphical conclusions as regards the type of the unconformity should be based on Fig. 3.

Other problems associated with irrigation must be mentioned only cursorily. Satisfactory hydrodynamic theories on which may be based equations for the flow of water in a deep soil are still to be sought. Even the comparatively simple case of the discharge of a tube well in a deep soil, unprovided with the conveniently situated impervious layer

always found in theoretical descriptions, is open to obvious objections. The most illuminating model of such cases appears to be that of surface disturbances in an infinitely deep and highly viscous fluid. This analogy has been studied mathematically by Bose.[4]

The design of channels is determined primarily by the amount of silt which they must carry and discharge on the irrigated fields if the system is to remain working. The transport of silt by water in turbulent flow, both as it affects the intake from the river at the headworks, and the regime of the canal, still awaits scientific description. With the problems which arise in the design of irrigation works, in which model experiments, under properly adjusted conditions of dynamical similarity, alone enable three dimensional problems to be solved, enough will have been said to indicate the scope awaiting the application of mathematical and physical research.

A word may be added on the agricultural problems which are inseparable from questions of irrigation. Excessive irrigation and its evil effects have been mentioned, and may be regarded as a Scylla, between which and the Charybdis of the development of salinity, a safe course must be steered. With sparse rainfall the salts carried in irrigation water may accumulate in the soil, so that a too parsimonious economy of water, or reversion to well-irrigation without adequate replenishment of the water-table with fresh water, must result in a continuously increasing salinity of soil and ground water. It would appear that the only permanent solutions which can be looked for in the flat alluvial plains now considered, will be a combination of irrigation and drainage; in fact, it would be safe to state that any modern system of irrigation in alluvial plains must be designed at the outset with full provision for adequate drainage.

Very much therefore remains to be done in designing effective remedies for existing systems and in the physical and chemical questions of reconditioning damaged soils.

[1] Lindley, *Punjab Irrigation Branch Papers* No. 31.
[2] Wilsdon and Sarathy, *Punjab Irrigation Research Memoirs*, vol. 1, Nos. 1 and 2.
[3] R. A. Fisher, *Phil. Trans.*, B, **213**, 309; 1925.
[4] N. K. Bose, *Punjab Irrigation Research Memoirs*, vol. 2, 1929.

Obituary.

SIR GEORGE WATT, C.I.E.

THE death of Sir George Watt removes a figure who did valuable work for India, from which he retired nearly a quarter of a century ago. He will be always remembered for his "Dictionary of the Economic Products of India". Few would dispute the very great value on Indian economic development which has resulted from this publication.

Watt was born at Old Meldrum in Aberdeenshire in April 1851, the third son of John Watt. He married in 1873 Jane, elder daughter of Robert Simmie, who was Customs and Excise Officer at Lossiemouth. A son, Dr. R. H. Watt, and two daughters survive him. Watt was educated at the Grammar School and Marischal College, Aberdeen, and then went to the University of Glasgow in 1871, graduating M.B. and C.M. He had obtained distinction in botany, and this led to his appointment in 1872 as professor of botany in the University of Calcutta, a post he held for twelve years. In 1882 he was appointed scientific and medical officer on the Burma-Manipur Boundary Commission. His work and enthusiasm were beginning to attract the notice of the Government of India, and in 1883 Watt was appointed to the charge of the Indian Section of the great International Exhibition held in Calcutta in that year. The following year he received the definite appointment of assistant secretary for scientific purposes to the Revenue and Agricultural Department of the Government of India. In 1885 he went home and held charge of the Imperial Indian Economic Court of the Indian and Colonial Exhibition, an exhibition which fired the imagination of the public school youth of the day.

By this time Watt appears to have convinced himself of the grave existing need for a better knowledge of, and comprehension of, the value of the enormous number of what, *faute de mieux*, were termed the economic products of the country. He was able to impress the Government of India with his views, and in 1887 was appointed Reporter on Economic Products to the Government, a new post. It has been said that Watt had been turning his attention to this question of the economic products of the country and he had commenced in 1885 collecting material for the compilation of a dictionary on the subject. With his official apointment he was able to take up this project seriously and by 1894 the nine fine volumes of the "Dictionary" were completed. The work was a standard one and, unfortunately, owing to the unexpected demand, went out of print at an early date.

When Watt compiled the "Dictionary" there was no Agricultural Department to the Government of India, no Pusa and no Forest Research Institute at Dehra Dun. Watt's project was invaluable but, with no idea of belittling his magnificent work, it should be stated that the "Dictionary" would never have seen the light of day had it not been for the loyal, intelligent, and enthusiastic assistance accorded to him by collectors and deputy commissioners of districts and their staffs, and by the forest officers throughout the country; and the latter, owing to their training in scientific method and deduction, were perhaps in a better position to submit reports in a readily utilisable form. Many, if not most, of the inquiries originated with Watt, and circulars were issued asking for co-operation in instituting investigations and often in carrying them to a conclusion, where practicable, out in the districts. There is little doubt that Watt's initiative in this respect aroused the interest of many junior officers in this matter of economic products.

I had not been three months in India before a conundrum in one of the circulars was given me to deal with, and several most interesting months were passed in endeavouring to submit a satisfactory solution.

The "Dictionary" was not intended as a text-book or handy handbook, but it was a first definite departure in the study of the economic products and served as the basis for the great development of this study which has since come about. Watt retired in 1906, but the post of Reporter was not finally abolished until both the Pusa and Dehra Dun Institutes were firmly established. Watt's ledger files, which he had maintained over a long period of years, were then made over to these latter. He had also edited an invaluable publication known as the *Agricultural Ledger* from 1892 to 1903, which was continued by his successors. He was also in charge of the industrial section of the Indian Museum at Calcutta.

It was during Lord Curzon's Viceroyalty, to some extent due to the fact that the "Dictionary" was out of print, that Watt was asked to prepare, with the guidance of a small expert committee in London, an abridged edition of the "Dictionary", to be brought up-to-date and to be issued in one volume. This work, under the title of "The Commercial Products of India", was published in 1908.

Watt was president of the Pharmacological Section of the Indian Medical Congress in 1894. In 1901 he was appointed to the Indigenous Drugs Committee, and as secretary drafted the report. In 1903 he organised an Indian Art Exhibition in connexion with Lord Curzon's Delhi Durbar.

After his retirement from India, Watt made a special study of cacao cultivation, visiting Portuguese West Africa for the purpose in 1912, and patented machinery for cacao manufacture. He served for five years as lecturer in the botany of Indian trees at the University of Edinburgh. He was made C.I.E. in 1886 and was knighted in 1903; he was LL.D. of both his old Universities, Aberdeen and Glasgow; a fellow of the Linnean Society; and had received distinctions from a number of foreign universities and scientific societies.

In addition to the "Dictionary", Watt published "Pests and Blights of the Tea Plant"; "Rhia and China Grass"; "Lac and Lac Industries of India"; and an important work on the "Wild and Cultivated Cotton Plants of the World".

Watt had settled at Lockerbie in 1910 and identified himself closely with local affairs, serving on the Dumfriesshire County Council and Education Authority. His death on April 2 will be much felt by many, and not least by the band of men who were identified, one way or other, with his valuable Indian work. E. P. STEBBING.

PROF. I. P. BORODIN.

PROF. IVAN PARTHENIEVITCH BORODIN, whose death at Moscow was recently announced, was a botanist and forester of international reputation. Born at Novgorod in 1847, he was educated at the University of St. Petersburg, where he became professor of botany in 1887, a position he held for three years. He then became professor at the St. Petersburg Forest Institute, where he continued for thirty years. This was formerly the largest and probably the best equipped forestry school in Europe, and many foreign students were attracted to it by the prestige of Borodin and the scientific staff. In 1897 he founded the biological fresh-water station which bears his name and of which he was director.

Borodin's first researches were on the effect of light on the higher cryptogams, and he also worked on respiration. An early paper, however, on botanical progress during 1877–79, indicated the catholicity of his interests shown later by his publications on mycology, anatomy, reproduction, and biochemistry. He also wrote standard books on botany and agriculture.

The study of botany in Russia owes much to Borodin's zeal and versatility, and this is shown by the numerous honours conferred upon him. He was of strong physique and enormous energy, attributes which served him in good stead in the arduous botanical travels he undertook in the remoter parts of Siberia and the Caucasus. His interest in travel continued to the end, and he served as president of the standing commission for the development and exploitation of tropical countries. He held several other positions to which the term honorary is usually applied, but Borodin devoted himself to his duties with intense earnestness and clear thinking enthusiasm. He was a man with many friends in his own and in other countries.

PROF. HERMAN VON IHERING.

PROF. HERMAN VON IHERING, who died at Büdingen in Oberhessen on Feb. 24 in his eightieth year, is well known from his contributions to the biology and palæontology of South America, where he was for many years Director of the Museum at São Paolo, Brazil.

Von Ihering was especially interested in zoogeography and in order to test its problems by various groups of animals, specialised on land and freshwater mollusca and on the social insects, especially the wasps. He had also a good knowledge of the South American mammals, recent and fossil. He also wrote on the Antarctic faunas, the German Selachians, and the fossil and living mollusca of South America. He was a man of original and independent views and was often engaged in controversy, on one occasion with Ray Lankester. He was a pioneer in the application of parasites to zoogeography and it is often called "the von Ihering method".

Von Ihering wrote many memoirs on the anatomy and classification of the land mollusca and on the biological relations of South America. His last general work was his "Die Geschichte der Atlantischen Ozeans" (June 1927), wherein he summarised and restated his former conclusions, and advocated fundamental changes in both Atlantic and Pacific geography up to the middle of the Kainozoic era.

After his return from South America, von Ihering was honorary professor of palæontology in the University of Giessen. Many of his views were rejected when first advanced, but are now receiving wider recognition and acceptance.

PRINCIPAL J. YULE MACKAY.

JOHN YULE MACKAY, whose death on Mar. 30 we regret to record, was a distinguished student of the University of Glasgow. After graduation in medicine in 1882, he became Cleland's senior demonstrator and lecturer on embryology.

Mackay was successful as a teacher, and, in addition, he produced original work of permanent value. He devoted his attention mainly to the vascular system, and wrote a monograph on the morphology of the arterial arches in birds which was published in 1888 in the *Transactions of the Royal Society*. He was with Cleland the originator of the "Memoirs and Memoranda in Anatomy" which was issued from the Glasgow School, and its first volume, published in 1889, contained an interesting paper by him on "The Arterial System of Vertebrates Morphologically Considered", in which from his comparative observations, he constructed a scheme of the classification of the branches of the aorta, the correctness of which has been confirmed by subsequent embryological observations. His ability and energy were shown also in the volume on "Human Anatomy: General and Descriptive", which he produced in association with Cleland.

Shortly after Mackay's appointment to the chair of anatomy in University College, Dundee, he was selected to be the principal of that College, and he held the dual posts until a few years ago, when he resigned the chair but retained the principalship. He was for many years the University representative of the University of St. Andrews on the General Medical Council, and until recently was the chairman of the Education Committee of the Council.

D. W.

WE regret to announce the following deaths:

Dr. J. H. Appleton, emeritus professor of chemistry at Brown University, known for his work in industrial chemistry, on Feb. 18, aged eighty-six years.

Dr. Asaph Hall, of the U.S. Naval Observatory, vice-president in 1900 of Section A of the American Association for the Advancement of Science, who was known for his work on the orbits of planetary satellites, on Jan. 12, aged seventy years.

Prof. Conrad Keller, professor of special zoology in the Technical Highschool, Zurich, author of works on the origin of domestic animals, aged eighty-two years.

Dr. W. A. Orton, director of the Tropical Plant Research Foundation, formerly plant pathologist in the U.S. Department of Agriculture, and president in 1921 of the American Phytopathological Society, on Jan. 7, aged fifty-two years.

Dr. R. F. Ruttan, emeritus dean of the faculty of graduate studies and research at McGill University, past president of the Royal Society of Canada and of the Society of Chemical Industry, on Feb. 19, aged seventy-three years.

Prof. L. Vialleton, honorary doyen of the faculty of medicine of the University of Montpellier, author of works on histology, evolution, and other zoological topics, aged sixty-nine years.

News and Views.

ON May 10 occurs the centenary of the birth of the distinguished French chemist, François Marie Raoult. The son of a customs officer, he was educated at Laon and Paris, became a teacher, held various appointments at Rheims and elsewhere, and in 1870, at the age of forty, succeeded to the chair of chemistry at Grenoble, where the remainder of his life was passed. His earliest researches were largely connected with the phenomena of the voltaic cell, but his name is best known for his work on solutions, which occupied the last two decades of his life. His first paper on the depression of the freezing points of liquids by the presence of substances dissolved in them was published in 1878. Continued experiments with various solvents led him to the discovery of a simple relation between the molecular weights of substances and the freezing-point of the solvent which he expressed in the "loi générale de la congélation". He also studied the diminution of the vapour pressure of a solvent caused by dissolving a substance in it, and his important work in these directions was afterwards used by such eminent investigators as van 't Hoff and Ostwald in support of the hypothesis of electrolytic dissociation in solutions. An account of his work was given in a memorial lecture in 1902 by van 't Hoff before the Chemical Society, of which Raoult had been elected a foreign member in 1898. A modest, retiring, and dignified man, he lived mainly for his work, the value of which was recognised by the award of prizes by the Paris Academy of Sciences and of the Davy Medal of the Royal Society. His death took place on April 1, 1901.

FOR the public Kew is a delightful pleasaunce, for the gardener a demonstration of achievement and a suggestion of possiblities, and for the botanist a storehouse of information and a centre for research. The recently issued number of the *Bulletin of Miscellaneous Information* (Appendix I., 1930), comprises under this familiar but somewhat unattractive title, a review of the work of the various departments of the Royal Gardens during 1929. In 1925 work was begun on the formation of a National Pinetum at Bedgebury, in Kent, as the nearness of London is not conducive to the growth of conifers; and in spite of the long cold winter and abnormally dry summer of 1929, good progress is reported. The abolition of the penny charge for admission to the gardens from August Bank Holiday onwards is reflected in an increase in the number of visitors of nearly 220,000 between August and December, as compared with the corresponding period in 1928. The hard winter of 1928–29 and the boisterous gales of the last two months of the year caused severe losses among shrubs and large trees, but the long hot summer gave an unusual brilliance of colour to the abundant crops of fruits and berries on

many of the trees, and the later incessant and heavy rains effectively cleansed trees and shrubs from soot and dirt.

THE more strictly botanical activities of the Royal Botanic Gardens, Kew, have benefited by generous grants from the Empire Marketing Board, which have rendered possible visits by the scientific staff and various collectors to different parts of the Empire overseas and elsewhere, resulting in valuable accessions to the gardens and herbarium, and the gain of invaluable experience to individual members of the staff. Mr. Hutchinson's botanical tour in South Africa produced a harvest of more than 3000 species, including a large number of living succulent plants. Work of botanical exploration has also been carried out in British Guiana, Persia, Somaliland, and the Solomon Islands. Considerable additions have been made to the herbarium, mainly by the incorporation of stored material. An important feature of the work is the international co-operation in research rendered possible by an extension of the system of reciprocal loans between important botanical institutions; during the year more than 9000 specimens were borrowed and nearly 6000 sent out on loan. Botanical work in South Africa will be greatly facilitated by an arrangement to present to the National Herbarium at Pretoria duplicates of authentic specimens in the Kew Herbarium. The report of the museums records an increasing interest taken in the economic products of plants, involving much correspondence and discussion of home and colonial products with visitors. The difficulty in answering questions as to possibilities of new crops for home or the colonies is often enhanced by the lack of discretion on the part of optimistic journalists. An interesting acquisition is a new sundial constructed and presented by Prof. C. V. Boys, which was described in NATURE of Dec. 21, 1929.

WE have received a letter from Prof. G. E. Gates, of Judson College, Rangoon, in which he directs attention to the loose way in which authors of zoological papers still frequently refer to species of earthworms, even when these actually supply the material of their investigation. Thus a recent writer speaks of "the common Australian (European) earthworm"; the question is, What is meant? Presumably, says Prof. Gates, one of the peregrine Lumbricidæ that have been imported into Australia and have become acclimatised in settled areas around the cities. But "at least six species of Lumbricids have been recorded from Australia: *Eiseniella tetraedra*, *Eisenia fœtida*, *Allolobophora caliginosa*, *Bimastus constrictus*, and *Octolasium lacteum*. These worms when found elsewhere are usually present in considerable numbers, so that to each one of them the adjective 'common' might be applied. Thus an investigator who procures his earthworms from manure piles might regard *E. fœtida* as the common species, while another investigator who gets his material from the very same locality but at a distance of a very few feet from the manure piles would probably find another species to be the common form. Similarly a thick grove or river bank only a short distance from both the preceding places might have still other common species. The phrase 'the common earthworm' in such a region must therefore be nearly as meaningless as 'the common bird' or 'the common fish' would be." Even though one of these species should happen to preponderate so largely in one particular place as to deserve the name, locally, of 'the common earthworm', outsiders cannot be expected to know which is meant. The importance of the matter, as Prof. Gates points out, lies in the fact that in such cases corroboration of the results obtained is impossible, and their value, therefore, very considerably diminished, because of the anonymity in which the animal concerned is shrouded. It is not only the Oligochæta which are thus cavalierly treated by authors; in the same paper which calls forth these remarks, the monocystid parasites with which the writer is concerned are also left specifically undetermined.

THE issue of the *Times* for April 26 contains a letter from Sir John Rose Bradford, president of the Royal College of Physicians, in his capacity of Chairman of the Harvey Church Memorial Fund, appealing for funds for the restoration of the tower of Hempstead Church, Essex, the resting-place of William Harvey, which collapsed in 1882. An appeal was made in the *Times* last January not only to individual practitioners of medicine, but also to medical corporations, institutions, societies, and schools, with the result that some £1500 of the £5700 required has been raised. The present appeal is primarily directed to members of the medical profession, by whom Harvey is generally regarded as second only to Hippocrates, but it is hoped that it will provoke a generous response from laymen as well, particularly those who can appreciate Harvey's exhortation to the fellows of the Royal College of Physicians "to search and study out the secrets of nature by way of experiments". The present dilapidated condition of Hempstead Church has not infrequently created an unfavourable impression upon the foreign medical men who have made a pilgrimage to Harvey's tomb. A new importance is now assumed by the erection of a worthy memorial to Harvey at a time when, as we noted in our issue of April 19, a special effort is being made to establish a post-graduate school of medicine in London and to attract foreign students to Great Britain. Donations should be made payable to the Harvey Memorial Fund, and may be sent to the honorary treasurer, Mr. A. W. Ruggles-Brise, Spain's Hall, Braintree; or to Dr. Arnold Stott, 58 Harley Street, W.1, who is joint honorary secretary with the Vicar of Hempstead.

AN interesting tradition has long been current that Comenius (Jan Amos Komensky) the famous seventeenth-century pedagogue, was invited to accept the presidency of Harvard College, founded in 1636. The evidence that such an offer was made by the younger John Winthrop (1606–76), Governor of Connecticut, rests upon the authority of two references to it by Cotton Mather, of Boston, in works published in 1702 and 1726. Recently, Mr. R. FitzGibbon Young has re-examined the evidence

("Comenius and the Indians of New England", pp. 28. University of London School of Slavonic Studies. Price 3*s*. net) and, by taking into consideration the circumstances of time and place, has concluded that whilst there is definite evidence that Comenius was invited to New England, the presidency of Harvard was not vacant when Winthrop could have seen him. Nevertheless, his pan-sophic educational schemes received the careful consideration of contemporary American educationists. Mr. Young has also traced Comenius's connexions with Robert Boyle, Dr. Wilkins, Sir Kenelm Digby, and other members of the "invisible college" which was later to become the Royal Society. It would seem that the intention of certain savants, both in England and America, was that Comenius's methods of instruction should be applied to the unsuccessful attempt then set on foot for educating the American Red Indians upon the most advanced western European lines. Nothing came of the project, but Comenius's views can still be regarded as of some historical interest.

FOLLOWING the decisions at Düsseldorf in 1910, the sixth session of the International Congress of Mining, Metallurgy, and Applied Geology will be held at Liège on June 22–28 next during the International Exhibition of 1930. These meetings will be under the gracious patronage of His Majesty King Albert and of the Belgian Government. The Congress has been organised by the Liège Association of Engineers and the Geological Society of Belgium at Liège, in consultation with the societies which took part in the Conference at Düsseldorf. The work of the Congress will be divided into three sections: (*A*.) Mining Section, which will include reconnaissance and preliminary work, modern methods of working coal mines, metalliferous deposits and quarries, generation and utilisation of energy, extraction, ventilation (gas and dust), and mechanical treatment of ores and coal; (*B*.) Metallurgy Section, which will deal with blast-furnace practice, steel and ferrous alloys, foundry work, non-ferrous alloys and fuels; (*C*.) Applied Geology Section, covering metals, fuels, hydrology, and geophysical prospecting. Further information can be obtained from the general secretary of the Organising Committee, 16 Quai des États-Unis, Liège.

EVER since its formation in 1884, the North-East Coast Institution of Engineers and Shipbuilders has paid attention to engineering education, and in 1903 and 1907 it published reports on the training of apprentices. After the reading of a paper in October 1926 by Sir T. Morison entitled "How should an Engineer be trained?", the Education Committee of the Institution was requested to consider the training of candidates for official positions in the engineering and shipbuilding industries, and, in a short but valuable report entitled "Engineering Training for Officer's Rank", the results of its inquiries have just been published. 'Officer's rank' is considered to denote that a person possessing it has a reasonably broad acquaintance with the application of scientific principles to engineering, a certain amount of scholarship, and some practical knowledge of all the trades or professions which are employed in engineering works; while the report refers mainly to the training of marine and mechanical engineers, shipbuilders, and naval architects.

THE Education Committee of the North-East Coast Institution of Engineers and Shipbuilders regards the obtaining of a university degree in applied science as assuring a satisfactory standard of scholarship and as the normal road to officer's rank in the engineering profession, but one of the points stressed in the report is the desirability of a preliminary training in the works before the student enters upon his university course. "It is extremely desirable, as a preliminary to entering the university, that some experience of handling and fashioning actual materials, and of seeing what engines and ships and their parts look like in different stages of their construction, should be acquired." This view was supported by 94 per cent of the firms to which a questionnaire was sent. Appended to the report are outline schemes of training for both the shipyard and the engineering workshop. The carefully considered views of the Committee will be read with interest by those teaching in technical schools and colleges, and the report should also be of value to parents of boys desirous of becoming engineers.

THE opening of direct electrical communication between Madrid and Buenos Aires on Oct. 12, 1929, marked the completion of a wonderful engineering feat for which the International Telephone and Telegraph Corporation deserves great credit. The radio link installed is capable of connecting any telephone in the principal cities of Europe to any telephone in the principal cities of Argentina, Chile, and Uruguay. The length of this link (6400 miles) is twice as great as that connecting Britain with the United States. The radio path cuts the meridian at the equator at an angle of about thirty-four degrees. It passes through zones notorious for atmospheric disturbances and through the equatorial region where radio transmission is particularly subject to fading. Devices have been installed to counteract the effects of fading and, in addition, echo suppressor circuits which prevent the speech being reflected at the distant ends have been permanently installed. In order to give a trustworthy service over the entire day, three wave-lengths are used at each transmitter. A wave-length of 15 metres (20,000 kilocycles) is employed in the daytime, 20 metres for sunset and sunrise conditions, and 30-metre waves (10,000 kc.) are used at night. In order to reach Montevideo in Uruguay and some of the important cities in Argentina, it was necessary to place a telephone cable under a very broad portion of the River Plate and to cross some very high mountains where snow prevents train traffic at certain periods of the year. Serious trouble has been experienced in Argentina, where enormous cobwebs are blown by high winds into the circuits and effectively short-circuit them. In *Electrical Communication* for February many details are given of the system. Extensions have been made to Chile, which will add

many cities in that country to the Buenos Aires-Madrid link. In two years' time the toll plant to Bogota will add Colombia to the system.

THE transmission systems for railway electrification which are used in the Swedish State railways are novel and deserve special study by railway engineers. We therefore welcome a paper by I. Ofverhohm, the chief electrical engineer of the State railways, which is published in the *ASEA-Journal* (Allmanna Svenska Elektriska) for December. At the end of the year 1928, nearly six hundred miles of the State railways had been electrified and the electrified portion carried nearly a quarter of the whole traffic (in train-miles) of the railway system. Owing to special reasons, alternating current was used. The power required for the Kiruna—Riksgransen line, the so-called Ore railway, is produced by separate generators at the Porjus power plant, which is then stepped up to 80,000 volts for the transmission lines which extend for 250 miles along the railway, the average distance between the substations being about 20 miles. The southern part of the State railway from Stockholm to Göteborg, which is called the western trunk line, is supplied with electrical power from the national high voltage three-phase transmission lines. The voltage between the trolley wires and the earth in the Ore railway is 16,000 volts, and the frequency is only 15. The important difference between the two sections of the State railway is that for the Ore railway special transmission lines and transformer substations had to be constructed in addition to the trolley lines. In the latter case it was only necessary to construct motor generator stations in addition to the necessary trolley wires. One objection that has been often urged against the use of alternating current is that it would produce interference with telegraph and other communication circuits. The Swedish engineers seem to have overcome very easily by various methods described in the paper any troubles arising from this cause.

A REPORT on "Rational Organisation and Industrial Relations", which consists of a symposium of views by members drawn from the spheres of management, labour, and science, has recently been published (The Hague: International Industrial Relations Association, 1930. 3.50 fl., 6*s*.; to Members of the Association, 2.50 fl., 4*s*.). In a paper on "Rational Organisation", Mr. L. Urwick, director of the International Management Institute, Geneva, defines a rational or scientifically organised industry as a group of enterprises engaged in supplying similar or allied requirements to the community by methods involving the minimum waste of either effort or material. Rationalisation, he holds, is both an attitude and a process. As an attitude, it records the belief that a more rational control of world economic life through the application of scientific method is possible and desirable. As a process, it implies the application of scientific intellectual technique to all problems arising in the organisation and conduct of production, distribution, and consumption. An important lesson which recent experiments in scientific management have to teach is that the art of management and of organising large bodies of men must be based on a searching intellectual study of the underlying sciences bearing on it, coupled with that power of synthesised expression which is the distinguishing hall mark of real ability. Scientifically managed industry of the future will necessarily involve a substantial degree of workers' control, but the mechanisms and forms of that control would accord rather with the findings of comparative administration than with any political preconceptions. "Personnel Policy and Procedure" is discussed by Dr. C. H. Northcott, labour manager of Messrs. Rowntree and Co., Ltd., who holds that management should not wait for the workers to make a proposal. Even in such matters as wages, it is unfair to the workers that a grievance known to the management should remain uncorrected until complaints are made.

IN the *Engineer* for April 11 is an illustrated article on the s.s. *Seapro*, a fish-treating vessel which has just sailed for the south-west coast of Africa. Fish of many kinds are caught in the waters in that area, some of which are only fit for conversion into food for cattle, pigs, and poultry; some of which are valuable for their oil content; others the livers of which provide medicinal oil, and shellfish that furnish a table delicacy when tinned. Finally, there are other fish which are worth putting into cold storage for sale at any convenient market. To deal with these various classes of fish, the *Seapro* has been fitted up as a factory with hacking machines for tearing the fish into small pieces; drying machines for expelling the water; sterilising machines in which the albumen is coagulated and bacteria killed by being subjected to high temperature; a complete tin-making plant for making tins, and others for boiling and canning crayfish and for boiling the oil out of fish livers. The machinery, which is driven by electric motors, has been constructed by Rose, Downs, and Thompson, Ltd., of Hull, who specialise in the construction of fish meat plant. The actual fishing will be done by a fleet of motor-boats the crews of which will be recruited locally but who will live on board the *Seapro*, in which extensive native quarters have been provided. The *Seapro* is a vessel of 5305 deadweight tonnage, and before being altered for her present purpose was, under another name, engaged in the pilgrim traffic in the East.

THE cost of books to the reader, relative to the publications of different countries and to succeeding years, is not easy to assess with strict accuracy, and on this account the statistics collected by John R. Miner must not be pushed too far (*Quart. Rev. Biol.*, p. 598; 1929). They refer to the cost of the biological books received for review in 1929 by the journal mentioned. If these may be taken as fair samples of national production, of the great nations Germany heads the list as the most expensive retailer (1·65 cents a page), followed by England (probably meaning Great Britain—1·29 cents), United States (1·14), and France (0·47). The cheapest of all biological books are those published by the United States Government,

and next to them appear to come those of the British Government, but this statement is founded on a single example only. It is very striking, however, that during the four years of this annual survey, France has continued to produce the cheapest commercially published scientific books, costing on the average less than half as much as those of any other country. In all countries 1929 was marked by rising prices, varying from an increase of 18·3 per cent in British books to 4·4 per cent in French; United States commercial books show no difference, but their Government publications have risen 9·5 per cent. The longer view shows that while British and American books stand now practically at the price level of 1926, French books in the same time have increased in price 34·3 per cent and German books 51·4 per cent.

DR. A. NODON has contributed an article to *Savoir* (Mar. 15) which again raises the problem of the nature and origin of the cosmic rays. It seems to be undecided at present whether they are electromagnetic waves or corpuscles. Prof. Millikan's interpretation of the accurate absorption curves obtained by him and by his collaborators is not everywhere accepted, but, on the other hand, the evidence that the rays are corpuscular is as yet not completely satisfactory. Their place of origin, again, cannot be regarded as settled in the absence of more complete statistical analysis of the type made by A. Corlin, the accumulation of data for which is necessarily a lengthy procedure. Dr. Nodon has directed attention to the work on the cosmic rays which has been done in France at various times since the discovery that there was a real residual ionisation in electroscopes. The feature of the French work is that it tends to show that the penetrating radiation comes in part directly from the sun, and in part indirectly from the upper atmosphere, but not from the sun. The present position is most unsatisfactory and it does not seem possible to pronounce any certain judgment on the questions at issue.

THE anthropological surveys carried out and planned by the Bernice P. Bishop Museum at Honolulu promise to add much to the knowledge of the people of Polynesia. The Museum was founded in 1889 as a memorial to the Princess Panahi, last of one of the branches of the chiefs of Hawaii, with the stated object of the advancement of knowledge of "Polynesian and kindred antiquities, ethnology, and natural history". It was recognised that the problems of anthropology should be given a preferred position owing to the rapidity with which, on the death of the older people and in the absence of written records, reliable sources of information regarding native language, music, myths, social organisation, industries, and history, disappear. In carrying out the surveys, the investigators have, as it were, kept an eye on the clock, realising that vanishing data must be gathered at all costs, and that less urgent studies may well be excluded from the programme of immediate work. For the purposes of the survey, Polynesia has been divided into twenty-six areas, and eighteen surveys have been completed or organised. In addition to its ethnographical work, the Museum has done much to elucidate the flora and fauna of the Hawaiian area.

THE Zoological Survey of India was a fine conception which took shape under the enthusiastic guidance of the late Dr. Nelson Annandale, and the report for the years 1926–29 shows how solid is the foundation being laid for a knowledge of the fauna of India. Concerned equally with the field work on which advance of knowledge must be based, with the preservation and storage of the materials collected, and with the identification of specimens, the Survey finds its labours hampered in several directions. The director, Col. R. B. Seymour Sewell, suggested, therefore, that besides additional staff, there was need for a fire-proof building to house the collections, the library and laboratories, and of a marine biological station at Karachi. Force of circumstances has prevented the completion of these projects, but the appointment of an anthropologist should be of great service from the point of view both of the public galleries and of the scientific collection of data. Field work has been carried on in various areas, and now that the Chilka Lake survey has been completed, attention has been turned particularly to the fauna of the Nerbudda River. Appendices, occupying 44 pages, give lists of collections sent out and received, of an impressive series of type specimens added, of papers published, and so forth; but in these days of expensive printing, full lists of specimens added to the exhibited collections, of odds and ends received for identification, or of workers who used the library or laboratories, might be omitted without serious loss.

THE Zoological Society of London has had another most successful year. According to the Report for 1929, the number of visitors shows a decline from that of the previous year and the realised profit has fallen. But the former still exceeds two millions, and the latter, at £12,059, is in reality an improvement on the previous year, since there has already been debited against profit a non-recurrent loss of £2742 due to the centenary celebrations. The number of animals in the collections remains much the same as before—4095, excluding fishes and invertebrates—and this in spite of an abnormally high mortality amongst small mammals and birds which took place during the exceptionally severe and prolonged frost in January and February of last year. Otherwise the collections show a wonderful freedom from disease, for we can reckon out of count the deaths of thirteen penguins imported from the Falkland Islands in an infected condition. The gratifying decrease of tuberculosis, to which we have referred before, continues, the records showing ten cases fewer in mammals and eleven in birds, with only two cases amongst the Primates, as against forty-one in 1926 amongst the inhabitants of the old ape, monkey, and lemur houses—a fine justification of the new housing policy. In view of the scare regarding psittacosis, it is reassuring to learn that no case of this disease has been detected and no outbreak of epizootic disease has occurred in the Society's aviaries during the year. To the Report are appended the addresses by His

Grace the Duke of Bedford and Sir P. Chalmers Mitchell at the centenary celebrations, as well as shorter addresses by three representative delegates.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A temporary technical assistant in farm economics under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (May 10). Designers with experience in the design and construction of light precision mechanical or electrical machinery, for an Admiralty establishment near London—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (May 10). A physiological botanist under the Director of Agriculture, Mauritius—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (May 16). A university librarian for the Queen's University, Belfast—The Secretary to the Library Committee, Queen's University, Belfast (May 16). A head of the Building Department of Leeds Technical College — The Director of Education, Education Department, Calverley Street, Leeds (May 17). A senior science master at the City of Leeds School—The Director of Education, Education Department, Calverley Street, Leeds (May 17). A chief assistant in the Pottery Department of the North Staffordshire Technical College — The Clerk to the Governors, North Staffs Technical College, Town Hall, Hanley, Stoke-on-Trent (May 19). A junior lecturer in the department of inorganic and physical chemistry of Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (May 24). An assistant horticultural adviser to the County of Southampton Education Committee —The County Education Officer, The Castle, Winchester (May 24). An assistant director of agricultural education, a senior agricultural advisory officer, and a poultry advisory officer—The Director of Agricultural Education, Agricultural Station Offices, Sprowston, Norwich (May 24). A head of the mathematics and physics department of the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (May 30). An assistant lecturer in the department of mathematics of the University College of Swansea—The Registrar, University College, Swansea (May 30). Assistant meteorologists under the India Meteorological Department—The Director-General of Observatories, India Meteorological Department, Poona 5, India (June 29).

Our Astronomical Column.

Double Star Measures at Johannesburg.—*Circular* No. 80 of the Union Observatory is wholly occupied with double star measures made by Mr. W. H. van den Bos. There are 1393 measures of 604 pairs ; the 9-inch refractor is used for such pairs as are within its reach ; the 26½-inch for more difficult ones. Some pairs within reach of northern observers are measured for a check on personality in measuring. One of these is Sirius ; there are five measures of the principal pair *AB*, which agree closely with the ephemeris from Aitken's orbit ; two measures of the suspected third companion *C*, date 1929·213, give P.A. from *B* 132·6°, distance 1·54″ ; the note on one night is "*C* sharp and stellar regarded as quite certain, good measure" ; but a later note states that the real existence of *C* is still regarded as doubtful. A bar across the object glass was found to aid observation in this case ; there were dark lanes between the diffracted patches of light ; a faint object in these lanes was more easily seen ; it is suggested that the device might be useful for Procyon. Three companions of Nova Pictoris were measured ; position angles, 70°, 230°, 10° ; distances, 0·5″, 0·6″, 0·3″ ; dates not given. An interesting new close pair is ν Indi ; magnitudes, 6·1, 6·2 ; P.A. 0°, distance 0·14″. As this star has a parallax of 0·034″ (Voute), it is likely to show orbital motion. With the circular are issued twelve more sheets of the photographic star-atlas of the southern heavens that is being made with the Franklin Adams camera ; they are ruled with the lines of R.A. and Decl. for the equinox of 1875.

A New Determination of the Galactic Pole.—*Publication* No. 43 of the Groningen Laboratory, by Prof. P. J. van Rhijn, director of the Laboratory, is taken up with a careful analysis of the distribution of the faint stars, based chiefly on the photographs of the Kapteyn selected areas, but supplemented by the Franklin Adams photographs and some other sources. The stars used are very much fainter than those employed in obtaining the galactic co-ordinates that are in common use ; it is therefore not very surprising to find that the new position of the galactic pole differs considerably from accepted values. Thus, in the analysis the preliminary position of the galactic pole was that derived by Gould ; R.A. $12^h\ 42^m\ 34^s$, N. Decl. 27° 13′ ; that finally adopted is $12^h\ 56^m$, N. 25° 30′ (both are for the equinox of 1900). The publication contains tables for reducing R.A. and Decl. to this new system ; the remainder of it contains extended tables of the logarithms of the star density for different magnitudes and in different regions of the sky. The important result is deduced that the ratio of increase in the number of stars on extending the table from any magnitude (between the limits 15 and 18) to a value half a magnitude fainter is independent of the galactic longitude, and is the same on both sides of the galaxy.

Melbourne Astrographic Catalogue, Vol. 3.—This catalogue has just been published under the direction of the present Government Astronomer, Mr. J. M. Baldwin ; most of the photographs were taken and measured under his two predecessors, Messrs. Ellery and Baracchi. It covers the zones − 69° and − 70°, so that about half the stars in it occur twice, since each plate covers 2° in declination. There are 254 pages, and the average number of stars on each page is about 200. The diameters of the star images are given, and a table in the introduction gives the magnitude corresponding to each diameter : the faintest stars are of magnitude 12·9. The rectangular co-ordinates x, y of each star are given to the third decimal of a minute ; there are tables to facilitate the reduction to Right Ascension and Declination. The stars used for the plate constants are in heavy type. The reference numbers in the Cape Photographic Durchmusterung are given for all stars contained in that work, together with their magnitudes. The Melbourne section of the catalogue extends to the south pole, but the zones near the pole are very small, so that about half the whole area has now been published.

Research Items.

Polynesian Anthropometry.—Prof. Wood Jones prefaces a discussion of the anthropometry of the Polynesians in *Man* for April with certain preliminary considerations which he commends to the attention of anthropologists: First, that the question of the origin of the race has been obscured by a tendency to confuse the point of their mixed origin with that of a tendency to hybridisation shown in the agelong toleration of admixture with alien blood; secondly, that anthropologists have neglected the methods of their fellow-workers in other branches of zoology, though recently Sir Arthur Keith has brought the study into line by regarding human races as varyingly perfected stages of human evolution; thirdly, correlation of growth must not be overlooked; for example, the correlation in length of vertebral column, base of skull, and maximum head-length. Turning more specifically to Polynesia, can anthropometric methods demonstrate, aside from recent admixture, the original blending of separate racial elements in the formation of a Polynesian type? Sullivan's observations were summed up by him as demonstrating two races in Polynesia. This was based on a method of selecting one characteristic and noting the status in a series in regard to other features; thus from an examination of "23 tallest men", "21 shortest men", and so forth. But in view of the zoological principle mentioned above, the results probably denote no more than that they represent the tallest and shortest individuals with the usual correlations of head and face. The same distinctive classification is obtainable from Burton's tables of Australian aborigines, but no one would suggest that this homogeneous group is derived from the crossing of two racial strains. The same criticism applies to the frequently repeated classification of the bones and skulls found in English Church crypts into 'conquerors' and 'conquered'—'Romans' and 'British', 'Saxons' and 'Danes'.

Origin of the Caste System in India.—In the *Indian Antiquary* for March is published the first instalment of a discussion of the origin of the caste system in India by the late Mr. Charles Hill. The civilisation of India is utterly different from any other type in the world. The word 'caste', of Portuguese origin, means 'purity'. The system is aristocratic in that birth is considered essential to the possession of certain qualities, yet it is democratic in the fact that theoretically the members of all the groups are on an equal footing. Expulsion, which follows on any cause, however slight or accidental, leads to the formation of a new caste when the breach is great or intentional, or a sub-caste when it is slight and accidental. The result is that there are now more than 2000 castes and sub-castes. According to tradition, the Hindus were originally divided into four castes only—Brahmans, a spiritual priesthood, Kshatriyas, warriors sprung from the arms and shoulders of Brahma; the Vaisyas, who provide the food, clothing, and other necessities of man, born of the belly of the god; and the Sudras, whose lot is servitude and issue from his feet. The first three are 'twice born' and wear the sacred thread, though the Vaisyas receive it only on marriage. All Hindus belong to one or other of these four original castes or classes. Though similar to classes which once existed in Persia, Egypt, and Arabia, they survived in India only. It is suggested that the caste system was inaugurated as a method of securing stability at a time of social upheaval, such as would have occurred when the rulers of the Aryans entered India after being expelled by force from their earlier home. That the caste system did achieve such stability is shown by the tenacity with which Hindus clung to it while exhibiting apathy to all forms of government and changes in it. The formation of new castes strengthens the bonds of caste, for all are equally a manifestation of Brahma, though of different qualities.

Manchurian Rodents and Disease.—In the steppes of Asia rodents play a significant part in the web of Nature, mainly on account of their enormous powers of multiplication. The tunnelling of underground burrows, the destruction of vegetation, and the tilling of the soil are all important activities, but for man their most vital part is that of possible disease carriers. It is undoubted that the sudden vanishing of many rodent plagues is due to epizootics, and many substantial reasons suggest that the epizootics occurring among the rodents of the steppes are associated with the spread of bubonic plague, which visits the region almost every year. With this possible association in view, Dr. Wu Lien-Teh, chief of the Manchurian Plague Prevention Service, Harbin, has published a useful account of the biology and pathology of the wild rodents found in Manchuria and Mongolia (*Bull. Pekin Soc. Nat. Hist.*, vol. 4, No. 2, p. 95, December 1929). Several of the rodents, such as the tarabagan (*Arctomys bobac*), the spring hares (*Alactaga* and *Dipodipus*), various voles, rats, and mice, have already been found to be susceptible to plague under natural conditions. Moreover, by harbouring plague during hibernation, some carry over infection from one plague season to another. It has been shown that domestic rats play an important part in the spread of the plague outbreaks, and attention is now being turned to the investigation of the source of the domestic rat infection, whether or not it may be connected with wild rodents.

Fluctuations of Manitoban Grouse.—For several species of animals it has now been shown that numbers fluctuate with a fairly regular rhythm, although the periodicity appears not to be identical for all species. To the growing list of regular fluctuations Norman Criddle would add the sharp-tailed grouse and ruffed grouse in Manitoba (*Canadian Naturalist*, April, p. 77; 1930). The years of plenty of these he associates with abundant locust years, and traces the relationship through the fact that grasshoppers are apparently necessary food for the young of the grouse. The reduction in numbers which follows years of abundance he suspects may be due partly to disease and perhaps partly to the activities of enemies, such as goshawks. But has the author proved his point about periodicity at all? His observations from 1914 to 1929 on the numbers of ruffed grouse nesting upon a 26-acre wood-lot clearly do not establish a rhythm, for if a rhythm exists, it approaches a ten-yearly period, and the observations cover only sixteen years. On the other hand, the graph showing the annual fluctuations of grasshoppers, sharp-tailed and ruffed grouse from 1895 to 1929 at Aweme, Manitoba, looks convincing with its three series of peaks occurring at intervals of ten years. But the figures upon which this interesting graph is based are not stated, and we are left to understand that it represents no more than an ideal representation of the general notes in a series of journals, and therefore, that its details and fine agreements have no numerical sanction. More should have been said about the character of the information upon which the graph and consequently the conclusions are based.

Rooting of Woody Cuttings.—Very contrary reports have been given by different investigators as to the effect of the buds upon the production of roots on hardwood cuttings. Van der Lek has recently described experiments which suggest that in willow, currant, and vine the production of roots is more rapid upon such cuttings when the buds are left upon them. He suggested that 'hormones' released from the developing buds might be responsible for this effect. W. A. Sledge points out, in a paper in the *Journal of Pomology*, Vol. 8, No. 1, January 1930, that root production in such cuttings is closely connected with cambial activity. He re-examines root production in cuttings from this point of view and confirms an early observation of Hartig that cambial activity begins on the shoots at the base of the buds and works from thence down the stem. In these cuttings, however, cambial activity is also resumed at the base of the cutting as the result of the wound, such cambial activity being quite independent of the presence of buds, as is shown by an examination of internodal cuttings, in which also cambial activity occurs at the proximal end of the isolated internode. Root production seems certainly associated with this renewal of cambial activity and the effect of the buds in enhancing root production in Van der Lek's experiments may be associated with the renewed activity of the cambium throughout the length of the cutting as the result of the early development of the buds.

Radioactivity of Granites and Granodiorites.—Dr. H. Hirschi has recently published in the *Schweiz. Min. und Pet. Mitt.* determinations of the radioactive elements in three important groups of plutonic igneous rocks. The results are summarised in the table below, the detailed references being as follows: (1) "Radioaktivität der wichtigsten Granitmassen des Gotthardmassivs." Bd. 8, Heft 2, 318-320; 1928. (2) "Radioaktivität des Albtal- und Schlossberg-Granits des südlichen Schwarzwaldes." Bd. 8, Heft 2, 321-322; 1928. (3) "Radioaktivität einiger Tiefengesteine vom nördlichen Baja California" (Mexico). Bd. 9, Heft 1, 1-2; 1929.

Ref.	Rocks and Localities.	Per gm. of Rock.		
		U($\times 10^{-5}$).	Th($\times 10^{-5}$).	K($\times 10^{-2}$).
1	*St. Gotthard Massif.*			
	Gamsboden Granite-gneiss	1·77	4·1	4·68
	Rotondo Granite	1·41	6·5	5·29
	Fibbia Granite	0·92	..	4·84
	Kristallina Granite	1·20	4·3	4·78
	Medelser Granite	0·74	3·4	5·18
2	*Southern Black Forest.*			
	Albtal Granite	1·32	4·4	5·03
	Schlossberg Granite	1·32	4·2	6·10
3	*Northern Lower California (Mexico).*			
	Granodiorite	0·28	2·5	1·91
	Granodiorite	0·24	1·7	2·32
	Granodiorite (border facies)	0·41	1·5	2·75
	Biotite - hornblende - quartz-diorite	0·25	..	2·95
	Granodiorite	0·37	2·2	..
	Biotite-granite	0·63	1·5	4·96
	Granodiorite	0·60	1·7	2·92
	Hornblende-granite	0·64	7·0	3·05
	Norite-gabbro	0·30	3·2	0·25
	Biotite - hornblende - granite	0·78	4·8	3·88
	Granodiorite—quartz-diorite	0·31	4·4	2·41
	Granodiorite	1·23	4·5	2·06

The Golconda Diamond Mines.—The first issue of the newly established *Journal of the Hyderabad Geological Survey* contains the annual report of the Survey, but is mainly devoted to a geological and historical account by Capt. L. Munn of the ancient diamond mines of Hyderabad; Golconda was formerly the capital of this State. Capt. Munn's compilation is supplemented, through the courtesy of the Royal Society, by a reprint of a paper on the subject read before the Society by the Earl Marshal of England in 1677. Up to the year 1728, this region was the sole source of the world's supply of diamonds, the Great Mogul or Koh-i-noor being among the more famous of the later finds. The earlier wealth has become proverbial and was responsible for the fabulous tales of Sindbad the Sailor and Marco Polo. The diamonds are found in the Pre-Cambrian Banaganpilly Group of quartzites and pebble-beds occupying a low position in the Vindhyan system, and it is noteworthy that at Wajra Karur "an igneous pipe, or neck, of bluish tuff-like rock exists". No gems have been extracted from this pipe and the real source is probably hidden beneath the Deccan traps. In 1890 a modern attempt to exploit the 'mines' was made, and 3444 stones were extracted before the enterprise was closed down in 1894 as being unprofitable.

Silica Glass at Meteor Crater.—A remarkable occurrence of lechatelierite or silica glass produced by the fusion of a saccharoidal sandstone at the bottom of the depression of Meteor Crater in Arizona is described by A. F. Rogers in the *Am. Jour. Science*, March, 1930. The only rocks in the immediate neighbourhood are sandstones, shales, and limestones, the nearest exposed igneous rocks being ten miles away. A temperature of between 1400° and 1800° C. was required to transform the quartz into silica glass. The latter occurs in comparatively large masses up to 15 cm. in thickness and could not have been formed, like fulgurites, by lightning. It is equally impossible that silica glass could be produced by a steam explosion. Barringer's well-known hypothesis that the crater was formed by the impact of a huge meteorite thus receives strong support, for no other explanation has been advanced that would equally well account for the melting of some parts of the sandstone floor and the shattering of other parts into a finely comminuted rock-flour.

A 100-Ton Testing Machine.—In the *Engineer* for April 4 is an illustrated description of a new 100-ton electrically-operated testing machine, which has been supplied by W. and T. Avery, Ltd., to the City of Leicester Colleges of Art and Technology. The machine is of the compound lever type. For tension tests it will take specimens up to 10 ft. in length and 3 in. in diameter; for compression tests, specimens 10 ft. in length and up to 12 in. square; and for bending tests specimens from 4 ft. to 14 ft. can be accommodated with a maximum width of 16 in. The straining crosshead is moved by three straining screws on the end of each of which is a spur wheel driven by a main worm reduction gear which in turn is coupled to a gear box driven by a reversible variable speed electric motor. The crosshead can be moved at speeds varying from $\frac{1}{10}$ in. to 8 in. per minute. The scale on the steelyard is machine-engraved from zero to 100 tons by divisions of 1 ton, and a micrometer screw dial subdivides these readings into $\frac{1}{100}$th ton divisions. Mounted on the top of the steelyard column is an autographic recorder.

Quantitative Analysis by X-Rays.—The April number of the *Proceedings of the Royal Society* contains a paper by C. E. Eddy and T. H. Laby on the quantitative analysis of alloys by means of their X-ray emission spectra (see also NATURE, April 5, p. 524). The fundamental assumption made is that the ratio of the number of atoms of two elements in an alloy

is equal to the ratio of the intensities of corresponding lines in the X-ray spectra of the elements, provided that the lines are excited under equivalent conditions, and that the elements are nearly equal in atomic number. The experimental determination of the relative intensities of the lines is made by making the alloy the target of an X-ray bulb, and analysing its emission spectrum by a rotating crystal spectrometer with photographic registration, the blackening of the X-ray film, as measured by a Moll recording microphotometer, being correlated with the corresponding intensity of the X-rays by the usual methods. In general, Prof. Laby and Mr. Eddy's results are more satisfactory than those of earlier workers in this field. They have paid some special attention to alloys in which the element to be estimated is present to the extent of less than one per cent, to which it is often difficult to apply other methods of analysis, especially when only small samples of material are available, and have also obtained good results for traces of lead in zinc, a case in which the elements differ widely in atomic number, and for which a modified method had to be devised.

Measurements at High Voltages.—The amount of power absorbed by the dielectric in an electric cable when working under various conditions is considered by many manufacturers to give valuable information as to the quality of the cable. In a paper on low power factor measurements at high voltages, which was read to the Institution of Electrical Engineers on April 4, Dr. E. H. Rayner, W. G. Standring, and R. Davis, of the National Physical Laboratory, give a critical study of the various methods adopted in practice for measuring these dielectric losses. When a high voltage is applied to unloaded mains, the ratio of the power absorbed to the product of the volts and amperes, that is, the power factor, is generally very minute. In this case the measurement of power presents many difficulties, as a small difference in the phase angle between the current and the pressure may make a large difference in the power measured. A standard air condenser, the difference between the plates of which is variable, has been constructed. It is suitable for use with 100 kilovolts. When the distance between the plates is 10 cm., the capacity, or, as it is now called, the capacitance, is 500 c.g.s. units. This condenser, when used with a Schering bridge, is found to give very accurate results. When using wattmeter methods of measurement, it was found that the non-inductive resistances or 'resistors' were often affected by stray capacitance currents. These errors could be eliminated if the resistor were shielded at every point by an electric field maintained at its own potential. The resistor used consisted of water flowing in tubes, and these were surrounded by others at the same potential. It was found possible by this compensation to keep the electric current in the water in phase with the applied voltage. Compared, however, with the air condenser, a resistor using a closed water circuit was relatively a troublesome piece of apparatus to use. During the experiments, the resistivity of the water was well maintained at 30,000 ohms for four months.

Carbonisation Tests.—It is frequently important to be able to estimate the value of a coal for carbonisation purposes by tests which can be carried out in the laboratory. All such tests exhibit the defect that large scale results cannot be exactly reproduced, and certain factors are necessary to correlate these with laboratory results. The Gray-King assay was devised at the Fuel Research Station for the evaluation of coal for purposes of carbonisation at low temperatures —600°—and the appropriate correlation has already been made. In *Fuel Research Technical Paper*, 24 (H.M.S.O. 1930, 9*d*. net), an account is given of a modification of the assay whereby higher temperatures are used and conditions conducive to secondary decomposition in the retort are provided. Factors which enable the results obtained with this new apparatus to be interpreted in terms of gas works carbonisation have been determined.

Fires in Bunkers and Cargo Coal.—The transport of coal by sea is fraught with a serious hazard of fire which continues to take a heavy toll in spite of generations of experience, and although radio communication has removed the worst terrors. The hazard has been the subject of repeated inquiry, and again, recently, by the Fuel Research Board, which has investigated 336 fires in bunkers and cargo coal in 272 ships (*Fuel Research Special Report*, No. 5, London: H. M. Stationery Office. 2s.). The net result of this inquiry is that 86 per cent of these fires could be assigned to definite and ascertainable causes, avoidable by suitable precautions. Only 14 per cent of the accidents were so unaccountable as to leave unavoidable spontaneous combustion as the only assignable cause. All fuel is liable to spontaneous combustion under certain conditions which coal chemistry has brought to light, and it seems that this fire loss is one which could almost be avoided by the application of existing knowledge. Shipbuilders might remove hot pipes and other sources of heat from bunkers or holds, and design ventilation systems so as to avoid leading air into large masses of coal in confined spaces. Shipowners might maintain bulkheads sound and tight. Certain precautions might be taken at coal staithes in the loading and trimming of coal. In short, a little scientific knowledge might leaven the practice of coal handling and, to judge from this report, a handsome dividend should accrue to both shipowners and underwriters.

Utilisation of Salt-Lake Deposits.—The great mineral wealth which is available in the form of salt-lake deposits in various lands has, up to the present, been very incompletely utilised, except for the extraction of ordinary salt. Prof. B. Panteleymonoff, of the Academy of Sciences in the Ukraine, contributes an article to the *Chemiker-Zeitung* of Feb. 22 on the progress which has been made since 1923 in the exploitation of Russian salt-lake deposits at the Rapa works. The article is written exclusively from the industrial point of view, and is not concerned with the great mass of purely scientific work which has already been carried out there. Among the problems investigated on the technical side is the production of compounds of magnesium and halogens. The magnesia obtained is of a high degree of purity. Iodine appears to be confined to those lakes which are in the neighbourhood of petroleum deposits, and the problem of its satisfactory extraction has not been completely solved. The possibility of the early exhaustion of the iodate deposits in Chile lends interest to this problem. Magnesium chloride is perhaps the most important of the products obtained, owing to the fact that its extraction leads up to the production of potassium chloride and magnesium sulphate from the mother liquors. The extraction of magnesium chloride from salt-lake deposits is a more difficult problem than that of its production as a by-product of the Stassfurt deposits. Bromine is either extracted with a solvent or recovered by distillation. The systematic design and development of undertakings for the utilisation of these deposits is of exceptional interest not only in Russia but also in America, France, Italy, and other countries which possess salt-mines.

The Unsaponifiable Fraction of Certain Oils.

IN attempting to concentrate the fat-soluble vitamins, investigators submitted the fats or oils containing them to saponification, and found that they passed unchanged into the unsaponifiable fraction. Subsequent work, especially in connexion with vitamin A, has led to increased knowledge of the constituents of this fraction of a number of natural oils and fats, although the identification of the vitamin itself has not been successful. At the same time a certain amount of attention has been directed to the physiological functions of some of these constituents. It may be of interest to review briefly some of the more recent work on this subject.

Fish Oils : Chemistry.

It is only natural that the unsaponifiable matter of cod-liver oil should have been thoroughly investigated, considering its importance as a source of supply of vitamins A and D ; much attention has been devoted to it, especially in Great Britain and Japan. Its content of unsaponifiable matter is, however, only small, about 0·7 per cent of the oil ; and half of this consists of cholesterol. In the other portion, Drummond and his colleagues have identified small amounts of squalene $C_{30}H_{50}$, and batyl alcohol $C_{21}H_{44}O_3$: they also found a small quantity of a hydrocarbon (unidentified), but considered that the main constituents are one or more unsaturated alcohols, possibly oleyl or selachyl alcohols (J. C. Drummond, H. J. Channon, and K. H. Coward, *Biochem. J.*, vol. 19, p. 1047 ; 1925 ; J. C. Drummond and L. C. Baker, *ibid.*, vol. 23, p. 274 ; 1929). Nakamiya and Kawakami (*Scient. Papers, Inst. Chem. Phys. Res.*, vol. 7, p. 121 ; 1927) claim to have isolated, amongst other products after the hydrogenation of the cod-liver oil concentrate, nonacosane $C_{29}H_{60}$ and batyl alcohol, but the identified compounds constitute only a small portion of the whole. They were, however, unable to detect squalene in their samples of cod-liver oil. Weidemann considers that the alcohols present are more unsaturated than selachyl alcohol (*Biochem. J.*, vol. 20, p. 685 ; 1926).

Certain other fish liver oils contain larger amounts of unsaponifiable matter, which is more easily fractionated than that obtained from cod-liver oil. That from the Greenland shark has been investigated by, amongst others, Drummond and Baker (loc. cit.) and Weidemann (loc. cit.). It contains about 15 per cent, of which cholesterol constitutes only about 14 per cent. Squalene is present in minute amounts (0·5 per cent of the unsaponifiable matter) ; the rest of this fraction consists chiefly of batyl (about 20 per cent), selachyl ($C_{21}H_{42}O_3$) and oleyl ($C_{18}H_{35}OH$) alcohols. The presence of the last two was indicated by the detection of batyl, and probably octadecyl, alcohols after hydrogenation.

The liver oil of the Japanese shark contains about 5 per cent unsaponifiable matter. Small amounts of cholesterol and possibly squalene were detected ; chimyl alcohol ($C_{19}H_{40}O_3$) is present to the extent of about 20 per cent, whilst the rest of the fraction is composed chiefly of selachyl alcohol.

Drummond and Baker reduced chimyl alcohol with hydriodic acid and obtained cetyl iodide and isopropyl iodide : their results indicated that the alcohol is a monoglyceryl ether of cetyl alcohol. Heilbron and Owen have shown that batyl alcohol is an ether of octadecyl alcohol and glycerol ; it probably has the formula $CH_3.(CH_2)_{17}.O.CH.(CH_2OH)_2$, since it is optically inactive (Drummond, *Chem. and Ind.*, vol. 49, p. 1, T ; 1930).

The hydrocarbon squalene contains six double bonds ; it forms a characteristic hexahydrochloride by which it can be easily identified. Channon has investigated its distribution in certain fish, and found it to be present in the liver oils of only three members of the Squalidæ family : it has, however, also been found in the livers of certain Japanese elasmobranchs (*Biochem. J.*, vol. 22, p. 51 ; 1928). It seems unlikely that it can be derived from the food ; in any case it was not found in the samples of plankton examined. The unsaponifiable matter of the liver oils of these fish formed a very high proportion of the oil, 67-73 per cent; other fish contained up to 33 per cent. In general the unsaponifiable fraction was considerably greater than in mammalian livers. It was noticed that in the Selachii there was an inverse relationship between the amount of unsaponifiable matter present and its sterol content, independent of whether squalene was present or not. There appears to be no relationship between the sterol and squalene.

Fish Oils : Physiology.

Channon has investigated the results of administering certain of these higher alcohols and squalene to mammals. He found that rats absorbed a certain amount of the latter when fed in daily doses not exceeding 0·075 c.c. a day or mixed to the extent of 1 per cent in the diet. In some of the experiments the fæces were collected during their course and worked up at the end with the livers and bodies of the animals ; in others, only the livers were examined for the presence of squalene (*Biochem. J.*, vol. 20, p. 400 ; 1926). The fæces were extracted with alcohol and ether, and the extract then treated as the other material. Saponification was followed by ether extraction of the unsaponifiable matter, which was again saponified and the solution extracted with ether. Cholesterol was removed with digitonin and the mother liquors extracted with ether. The residue, after removal of the solvent, was again dissolved in ether, and dry hydrochloric acid gas passed through the solution. The squalene hexahydrochloride so obtained was recrystallised from acetone. In one experiment, 2·77 gm. squalene were given to each rat over a period of 6 weeks ; 1·7 gm. was excreted. The unsaponifiable matter in the liver was increased up to $2\frac{1}{2}$ times that in the controls on the same diet and was half as much again in the carcass (without liver). The cholesterol content in the liver was doubled. The squalene actually recovered from the liver, however, only accounted for about half of the unsaponifiable matter left after removal of the cholesterol. The increase in the cholesterol with increase in the total unsaponifiable matter is the reverse of the relationship found in the fish oils mentioned above.

In further experiments with Collinson (*Biochem. J.*, vol. 22, p. 391 ; 1928) it was found that rats absorbed about 0·045 gm. daily of oleyl alcohol and phytol, 0·03 gm. up to 0·09 gm. of cetyl alcohol, and 0·017 gm. of cholesterol ; the two latter were given in dispersion in olive oil. Phytol appeared to be more readily absorbed than oleyl alcohol. These two increased the amount of unsaponifiable matter in the liver, and at the same time the cholesterol content was raised. Cetyl alcohol had no influence upon this fraction of the liver fat. The administration of cholesterol increased it four times, and the whole of this increase was accounted for by the deposition in the organ of cholesterol itself. It was also observed that the solubilities of these alcohols in bile follow the same order as the degrees to which they are absorbed. From some experiments of Mellanby with emulsified fat and squalene, it appears that particulate absorp-

tion of fatty substances may occur in the intestine, but only in the presence of bile.

These results led to a re-examination of the question as to whether liquid paraffin can be absorbed from the gut; rats and a pig were used (Channon and Collinson, *ibid.*, vol. 23, p. 676; 1929). Reliance was placed on the iodine value of the unsaponifiable fraction of the liver, together with an estimation of its cholesterol content to determine the presence of paraffin in this organ. The rats were given 5 per cent paraffin in the diet for five weeks, the pig 100 c.c. daily, mixed with gum acacia mucilage and a little food, for about eight weeks. The unsaponifiable matter in the livers of the paraffin-fed rats was increased 40 per cent; the cholesterol percentage was reduced, but the absolute amount was unchanged as compared with the controls; the iodine value of the non-sterol fraction was 31 instead of 119. Similar results were obtained in the case of the pig; in addition, a saturated hydrocarbon was actually isolated. The non-sterol fraction (expressed as a percentage of the liver weight) was increased 3½ times in the rats and 2½ times in the pig; but its iodine value in the latter was decreased to a third of that of the control.

Mammalian Oils and Fats.

Channon and Marrian have found an unsaturated hydrocarbon in mammalian liver, which is probably not squalene, although closely allied to it (*Biochem. J.*, vol. 20, p. 409; 1926). The unsaponifiable material was prepared from the livers of the pig, sheep, ox, horse, and man; the yields were 0·3-0·4 per cent. More than half of the material consisted of cholesterol, and pigments were also present. The hydrocarbon was obtained as a crystalline hydrochloride or an amorphous bromide, both of which are insoluble in ether, whereas the cholesterol compounds are soluble; by use of either method the hydrocarbon can be separated from the latter. Considerable purification was effected by making use of the fact that the hydrocarbon is insoluble in methyl alcohol, but it was not obtained in the pure state. It could not be distilled at 2 mm. Hg. pressure, decomposition occurring. The hydrochloride and bromide were analysed, but molecular weight determinations could not be carried out, since the hydrocarbon was not prepared in the pure state, and the salts are very insoluble and decompose at high temperatures. No squalene was found in these livers. The same hydrocarbon has also been detected by Drummond and Baker (loc. cit.) in sheep-liver fat.

Certain members of the petrel family store in their stomachs an oil, to which attention has been directed from the fact that it contains vitamins A and D. Rosenheim and Webster have examined the stomach oil of the fulmar petrel, which breeds on St. Kilda (*Biochem. J.*, vol. 21, p. 111; 1927). It was found that the oil is a liquid wax containing nearly 40 per cent of unsaponifiable matter; unsaturated higher alcohols and clupanodonic acid were found to be present, but there was only a small amount of glycerol; cetyl alcohol was not detected. In many respects the oil resembles sperm oil. The authors suggest that the bird uses the oil as a preening material. Both vitamins A and D were present.

Leigh-Clare has also found vitamin D in the stomach oil of the Australian petrel or 'mutton-bird' (*ibid.*, vol. 21, p. 725; 1927). Carter and Malcolm have also carried out investigations on mutton-bird oil (*ibid.*, vol. 21, p. 484; 1927). They consider that it consists largely of cetyl oleate together with esters of related alcohols and acids; it contains only traces of glycerol and little cholesterol. The origin of the oil is obscure. Experiments indicated that it could be digested *in vitro* by pig's pancreatic lipase, and that small amounts could be absorbed by the cat or the rat; cetyl alcohol in olive oil was also absorbed by the latter animal, a result which was confirmed later by Channon and Collinson, as mentioned above. Carter and Malcolm suggest that the presence of the oil in the stomach may be accidental, and that it is the tail gland secretion which has been swallowed.

Ether-soluble Substances in Plants.

Channon and Chibnall have investgated the ether-soluble substances of cabbage leaf cytoplasm (*Biochem. J.*, vol. 21, pp. 225, 233, 479, 1112; 1927: vol. 23, pp. 168 and 176; 1929). The material was prepared by mincing the leaves with water and squeezing through silk; the filtrate was then heated to 70°, when the cytoplasm was coagulated, and could be collected and pressed to free from excess water. The dried material was powdered and extracted with ether. From a third to a half of the total cytoplasm was extracted from the leaf; the ratio of the protein to the ether-soluble substances present is 3 to 1. The total amount of the latter in the leaf cytoplasm is about 3·5 per cent of the total leaf solids. Further fractionation was obtained by the use of solvents; soluble in acetone ether but insoluble in light petroleum are the pigments, chlorophyll 9·3 per cent, carotin 0·5 per cent, and xanthophyll 0·8 per cent of the total ether-soluble material; soluble in ether acetone and light petroleum, the glycerides and waxes—the fatty acids accounting for 17·5 per cent and glycerol for 1·3 per cent, and unsaturated unsaponifiable matter consisting of sterols 4·5 per cent, and unidentified compounds, probably alcohols and hydrocarbons, 13·3 per cent. The fraction insoluble in ether acetone could be subdivided into a fraction insoluble in hot acetone — calcium phosphatidate 18·4 per cent, unidentified calcium salts, possibly of fatty acids and phosphoric acid 5·0 per cent, and an unidentified iron compound 3·0 per cent, and a fraction soluble in hot acetone, the saturated unsaponifiable matter consisting chiefly of nonacosane and di-*n*-tetradecyl ketone, 12·3 per cent. There is an apparent loss of 14 per cent during the fractionations, the greater part of which is due to mechanical working losses, but it is possible that 5 per cent represents some other compounds, possibly hydroxyacids.

In the glyceride fraction, the results obtained suggested that palmitic, stearic, linolenic, and linolic acids were present, and possibly oleic acid also; palmitic accounted for two-thirds of the saturated acids and stearic for the remainder. The yield of fatty acids was higher in winter cabbage, that of the saturated unsaponifiable matter lower in winter than in summer.

Considerable attention was directed to the phosphatides; little if any phospholipin was detected, the major part of the ether-soluble phosphorus being present in the form of the calcium salt of a diglyceride phosphoric acid. The free acid and its lead salt were prepared, and barium glycerophosphate was also made from the former. The fatty acids present in the molecule appear to be stearic, palmitic, linolenic, linolic, or possibly oleic. The greater part of the acids in the molecule is unsaturated, whereas in lecithin and kephalin saturated and unsaturated acids are present in equimolecular proportions. The authors consider that phosphatidic acid may be a precursor of the lecithin and kephalin found in animal tissues rather than an *in vitro* decomposition product. There is already evidence in existence that calcium can be extracted from tissues with the kephalin fraction. The acid is a brownish oil, soluble in organic solvents, slightly soluble in water; the sodium salt is soluble in water, slightly soluble in cold alcohol, and insoluble

in ether; the barium, calcium, and lead salts are insoluble in water, acetone, and alcohol, but soluble in ether.

Nearly one-half of the phosphatide fraction is soluble in hot acetone. After purification by saponification, recrystallisation, and distillation, a material resembling paraffin wax was obtained, but the melting-point was indefinite, indicating that it was a mixture. By fractional distillation at 0·1 mm. pressure and crystallisation from benzene-alcohol, the hydrocarbon $C_{29}H_{60}$ was obtained in the pure state. The formula was confirmed by X-ray analysis. The higher boiling fractions from the distillation were treated with hydroxylamine; the ketoxime was separated from the hydrocarbon by means of its greater solubility in light petroleum and acetone, and the ketone finally regenerated by boiling in hydrochloric acid alcohol. X-ray analysis indicated that it was either $CH_3.(CH_2)_{13}CO.(CH_2)_{13}CH_3$ or $CH_3.(CH_2)_{14}.CO.(CH_2)_{12}.CH_3$; both were accordingly synthesised, when it was found that the substance was di-*n*-tetradecyl-ketone. Nonocosane and the ketone occur in the ratio of 3 to 1. Small quantities of other unidentified substances are also present in this fraction of the cytoplasm.

Maclean and her co-workers (*Biochem. J.*, vol. 23, pp. 107 and 634; 1929) have also isolated from cabbage leaves nonacosane and di-*n*-tetradecyl-ketone; from spinach leaves, however, the hydrocarbon hentriacontane, $C_{31}H_{64}$, was obtained.

In conclusion, it may be mentioned that Maclean has isolated from yeast fat a second sterol which she has named 'zymosterol'. The crude sterol was separated, by recrystallisation from alcohol, ether, and acetone, into the less soluble ergosterol, m.p. 158·5°, and a sterol, m.p. 108°-109° (zymosterol) (*ibid.*, vol. 22, p. 22; 1928). The latter is dextrorotatory (in ethereal solution), the former lævorotatory (in chloroform). It probably has the same number of ethenoid linkages as ergosterol and a very similar structure; it is precipitated by digitonin, but shows no selective absorption in the ultra-violet. It cannot be converted into vitamin D by irradiation (*ibid.*, p. 980).

International Congress of Archæology and Anthropology, Portugal, 1930.

READERS of NATURE will have in mind the recent criticisms of the international standing of the congresses in archæology and anthropology which have been held since the War under the auspices of the Institut International d'Anthropologie of Paris. These were summarised in the leading article in our issue of Mar. 1. In the recently issued announcement of the Congress to be held in Portugal on Sept. 21–30 next, it would now appear that the promoters hope to meet objections which have been raised on the ground that the Congress is not truly international in character by indicating that this congress will be a continuation of the older series of the International Congresses in Anthropology and Prehistoric Archæology, of which the last was held at Geneva in 1912. The invitation is issued jointly by the Conseil permanent du Congrès International d'Anthropologie et d'Archéologie Préhistorique and the Institut International d'Anthropologie. It is announced as the "xv^e Congrès International d'Anthropologie et d'Archéologie Préhistorique" and the "iv^e Session de l'Institut International d'Anthropologie"; finally, it is pointed out that the meeting coincides with the fiftieth anniversary of the Congress held in Lisbon in 1880.

While welcoming with all good will this expression of the desire of the members of the Institut that the congress should be regarded as truly international, it must be pointed out that it is not sufficient to call it so, or even to announce that it is a continuation of a former congress which has not met for eighteen years. The only international element in the organisation is the committee in charge of the preparation of the scientific proceedings, which, it is understood, has no executive power and on which Great Britain is not represented. The committees responsible for local arrangements at Coimbra and Oporto naturally are entirely local, but the publications committee is French with two exceptions. The real executive of the Congress, we presume, is constituted as before. The invitation is issued from the Siège Social of the Institut, namely, the École d'Anthropologie, and not from Lisbon.

Of the "Conseil permanent" of the older Congress, M. Marcellin Boule is a member of the Comité d'Honneur, and M. Pittard represents Switzerland on the committee in charge of the preparation of the scientific proceedings.

The Congress will be divided into sections, of which the first will deal with questions of morphological anthropology and functional ethnology, among the points specifically mentioned in this division being the methods of anthropology and especially the interpretation of statistics, the human brain from the racial point of view, endocrinology and human morphology, and the relation between the yellow races of Africa (Bushman) and the yellow races of Asia.

The second section will deal with human palæontology and prehistoric archæology, in which the question of the Kitchen midden people of Portugal, Armorica, and Denmark will be discussed. Another subject will be the distribution of cereals in neolithic times as well as the origin of domestic animals, particularly the dog.

The third section will deal with heredity, eugenics and cognate subjects, including criminology and psycho-sociology.

The fourth section is of a comprehensive character, covering ethnography, folklore, linguistics, religions, and human geography. One topic of discussion specifically mentioned is the geographical and ethnic origin of the Aurignacians. Primitive survivals among civilised peoples should give rise to lively discussion.

The session will be formally declared open by His Excellency the Minister of Public Instruction, Prof. Gustavo C. Ramos, on Sept. 21, at Coimbra, and a dinner will be given by the Rector of the University on the same day. On the following days, after the work of the sections has closed, conversaziones or illustrated lectures will be given in the evening. On Sept. 26 an archæological excursion will be made to Figueira da Foz on the way to Oporto. On Sept. 26 the Congress reopens at Oporto, on the evening of which day there will be a folk-lore fête at the Palais du Cristal, and on Sept. 27 the Congress will be formally declared closed, a banquet being held afterwards. On Sunday a motor expedition of archæological interest will be made to Guimaraes and Citania de Briteiros. The Congress will arrive at Lisbon on Monday, Sept. 29, at midday. A formal reception will be held by His Excellency General Carmona, President of the Portuguese Republic, and the following and final day will be spent in visits to museums and other places of interest.

Intimation of intention of attending the Congress and subscriptions should be addressed to le Trésorier de l'Institut International, 15 rue de l'École de Médecine, Paris (6^e).

Lime Requirement of Soil.

A SURVEY of the results from liming experiments in progress during the last twenty-five years at the Tennessee Agricultural Station was given by Prof. C. A. Mooers in his address as vice-president of Section O (Agriculture) of the American Association for the Advancement of Science at the recent Des Moines meeting, and has now appeared in *Science*, vol. 71, p. 81. The investigations have been carried out in the laboratory in conjunction with open air lysimeters of two types, one containing surface soil only, the other having in addition an under layer of heavy loam subsoil.

One of the early discoveries was the fact that silica readily combined with carbonate of lime with the formation of calcium silicate, a form of calcium more suitable for clovers than the carbonate. The idea that lime exerts a ' burning ' effect on soil humus has been refuted, neither calcium oxide nor hydroxide producing increased oxidation until their conversion into carbonate or silicate, and even then the increase was temporary only. As regards base exchange, the generally accepted view that potash is liberated by liming is shown to be erroneous, a normal application of lime actually repressing the leaching of this element.

Concerning the relationship between calcium and magnesium, new light has been thrown on many of the older studies. Liming with burnt lime or high calcic limestone was found to increase the calcium and depress the magnesium outgo, whereas additions of magnesium had the reverse effect. Treatment with a calcium-magnesium compound such as dolomite had the same result as the addition of magnesium only, these findings explaining the harmful action of high calcic limes on a magnesium-loving plant such as tobacco.

The question of the effect of liming on the oxidation of soil sulphur and nitrogen is also discussed, and the availability of added lime shown to decrease with time. The chief discovery made at the station, however, is the formation of ternary systems such as CaO-Al_2O_3-$CaSO_4$ by the action of aqueous solutions of calcium hydroxide and sulphate on aluminium complexes. Such systems are of low solubility when alkaline, but readily soluble in neutral or acid media. The reaction can be used to determine the reactive amount of alumina and silica, and is promising as a method for measuring the colloidal properties of a soil. It has already proved invaluable in affording an explanation of the disintegration of concrete under certain conditions which can now be avoided.

In conclusion, Prof. Mooers emphasises the importance of lysimeter experiments for both the chemist and plant physiologist.

Prickly-Pear Control in Australia.[1]

THE attempt that is being made to control the prickly-pear menace in Australia by biological means is a practical experiment of great interest and importance. The initiation and progress of this work has already been referred to in the columns of NATURE, and the most recent report on the subject has lately come to hand.

Since the year 1925, the measures taken to combat the scourge have greatly reduced, if not entirely arrested, its yearly spread to uninfested territory. The policy of the Prickly-Pear Board has been to introduce and acclimatise insects inimical to the growth of all the naturalised species of this plant. In carrying out this scheme, the natural enemies of prickly-pear in North and South America have been continuously investigated since 1920, and a number of species introduced, under adequate safeguards, into Australia. The cochineal insect, *Dactylopius tomentosus*, is now so widely diffused that there is scarcely an area of prickly-pear in Queensland or New South Wales which is not infested by this insect. The plant-sucking bug, *Chelinidia tabulata*, has multiplied and spread in enormous numbers, and the red spider, *Tetranychus opuntiæ*, gives every promise of soon extending throughout the length and breadth of the prickly-pear area. The moth *Cactoblastis cactorum* is a more recent introduction; about 300,000,000 have been liberated since 1926, and it is believed that within two or three more years it will become general in the desired areas. It is estimated that 30,000 acres of prickly-pear have been destroyed by this insect in about the last twelve months.

In this manner a complex of insect enemies has been established. Some species have naturally proved more successful than others, and their combined efforts are already bringing about a considerable measure of control of this pest plant. Its reduction is most noticeable in certain scrub areas where it once formed a barrier impenetrable to animals. In the heart of the infested country it is now possible to travel for 100 miles without seeing any flourishing plants. The production of fruit and new growth has become greatly diminished, fewer seedlings are able to become established, while large clumps of plants are being gradually sapped and destroyed.

On present indications, it is reasonable to expect that vast areas of prickly-pear will be freed within a few years. Too much confidence of complete eradication is to be deprecated, as the problem has not yet been solved, but the future prospects give reasons for optimism. The experiment has not yet had a long enough lease to enable an estimate to be made of the possible influence of such factors as varying or extreme fluctuations of climate, disease, and native insect parasites on one or other species in the complex that is being built up. Indigenous parasites and predators have indeed turned to some of the introduced insects but, up to the present, the influence they have exerted has not appeared to be great. Although such enemies need close observation being kept on their activities, there is no need for premature or undue alarm that they will materially vitiate the good results that are being achieved. A. D. I.

[1] "The Progress of the Biological Control of Prickly-Pear in Australia." By Allan P. Dodd. 44 pp. Commonwealth Prickly-Pear Board, Brisbane. 1929.

University and Educational Intelligence.

CAMBRIDGE.—The Cavendish professor has announced that the first course of Scott Lectures will be given by Dr. Niels Bohr at the Cavendish Laboratory at 4.45 P.M. on May 12, 14, and 16. The subject will be " The Principles of Atomic Theory ".

OXFORD.—Discussion still continues on the proposal to use the sum of £100,000 realised by the Radcliffe Trust for the establishment of an astronomical observatory in South Africa. The advocacy of the scheme by Prof. H. H. Turner is criticised by Prof. Lindemann on various grounds; he doubts, for example, whether any special benefit would result to Oxford in relation to other centres of astronomical study. Moreover, the climate of Oxford is not conspicuously worse than that of Greenwich, Edinburgh, or Cambridge; while even if it be allowed to be unsuitable for ' positional ' astronomy, there are many other lines of astronomical and meteorological research which are in need of assistance, and could well

be pursued in Oxford in consonance with the design of the founder of the trust. To this Prof. Turner replies that the scientific activities of Oxford are not, and should not be, confined to the actual precincts of the city; that additional observatories in the southern hemisphere are really needed; and that there may be a danger of undervaluing 'positional' astronomy, which has conspicuously proved its importance, in comparison with the more recent development of astrophysics.

THE Rockefeller Medical Fellowships for the academic year 1930–31 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1. These Fellowships are provided from a fund with which the Medical Research Council has been entrusted by the Rockefeller Foundation and are awarded to graduates who have had some training in research work in the primary sciences of medicine or in clinical medicine or surgery and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles. In special circumstances the fellowships may be tenable at centres of research not in America. A fellowship held in America will have the value of not less than £350 a year for a single fellow, with extra allowance for a married fellow. Particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

THE Salters' Institute of Industrial Chemistry is offering a limited number of fellowships for chemists of post-graduate standing, the object being to afford additional and special training at home and abroad preparatory to a career in industrial chemistry. The normal value of each fellowship is from £250 to £300. Applications must reach the Director of the Institute, Salters' Hall, St. Swithin's Lane, E.C.4, by June 2. The Institute will also, in July, allocate a limited number of grants-in-aid to young men and women employed in chemical works in or near London who are desirous of fitting themselves for a career in chemical industry. The latest date for the receipt of applications by the Director is June 7.

THE Ministry of Agriculture and Fisheries is offering until June 15 a number of agricultural scholarships for students who propose to take up posts as agricultural organisers, teachers, or lecturers in agriculture; also research scholarships in agricultural and veterinary science. In addition, it is prepared to receive up to May 15 applications for grants in aid of scientific investigations bearing on agriculture to be carried on in connexion with a university, university college, or other approved institution or society in England and Wales. Applications for all of the foregoing should be sent (upon forms A. 472/T.G., 900/T.G., and A. 53/T.G. respectively) to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1.

DANIEL C. JACKLING, of San Francisco, president of the Utah Copper Company, has made provision for the establishment at the Missouri School of Mines and Metallurgy at Rolla, of which he is a graduate of the class of 1892, of the Jackling Foundation for education in the sciences and arts pertaining to the mineral industry, the purpose of the Foundation being to offer loan funds and provide scholarships and special educational features not ordinarily provided for at State schools. The Foundation may eventually total £120,000. Of this amount £20,000 is to be used as loan funds and the income from the remainder for scholarships and special educational purposes.

Historic Natural Events.

May 6, 1915. Thunderstorm.—During the evening a thunderstorm of unusual violence broke over the centre of London. Between 8.30 P.M. and 10 P.M. more than two inches of rain fell over an area bounded by Piccadilly Circus, Euston Road, Shoreditch, and the Strand, the amount reaching 3·00 in. at Holborn and 3·12 in. at New River Head. Practically no rain fell south of the Thames.

May 8, 1663. Thunderstorm and Flood.—Concerning this Pepys wrote (May 15): "Strange were the effects of the late thunder and lightning about a week since at Northampton, coming with great rain, which caused extraordinary floods in a few hours, bearing away bridges, drowning horses, men, and cattle. Two men passing over a bridge on horseback, the arches before and behind them were borne away, and that left which they were upon: but however one of the horses fell over and was drowned. Stacks of faggots carried as high as a steeple, and other dreadful things; which Sir Thomas Crew showed me letters to him about from Mr. Freemantle and others, that it is very true."

May 8, 1902. Great Eruption of Mont Pelée (Martinique).—For two weeks beginning on April 25, the volcano had been active, throwing out columns of ash and steam. About 8 A.M. on May 8, a dark cloud was seen to issue from the volcano. Sweeping down the slope with great velocity, in two minutes it reached Saint Pierre, the chief city in the island. The blast was tornadic in its violence, its heat was withering, and it seems to have been charged with incandescent particles. The whole city was wrecked and, with two exceptions, all its inhabitants were killed, as a rule instantaneously, the number of dead in Sainte Pierre and its suburbs being reckoned at not less than 30,000. The area of complete destruction was a sector about 8 sq. miles in area, and as a rule its boundaries were sharply defined. There was no flow of lava and no large portion of the crater was blown away, though it is estimated that the discharge of solid matter per day was greater than that of the sediment carried down by all the rivers in the world combined. The sound of the explosion was heard at St. Kitts and St. Thomas (210 miles and 350 miles). Brilliant after-glows were observed at Honolulu, Madeira, Slough, Berlin, Bombay, and elsewhere.

May 9, 1818. Drought.—At Trevereux, near Limpsfield, Surrey, it is recorded that after a deluge of rain on May 8, no further rain fell until Sept. 5, being 17 weeks and 1 day, during which all vegetation was completely burnt up.

May 9, 1867. Shower of Hazel Nuts.—On the night of May 9, during a violent rainstorm, a remarkable shower of 'berries' fell in Dublin, on both sides of the river. They were described as having the form of a very small orange, about half an inch in diameter, black in colour, and when cut across seeming as if made of some hard dark brown wood. They fell with such force that even the police were forced to seek shelter. The 'berries' were afterwards identified as hazel nuts which had been partly fossilised in a peat bog. How they came into the air is not known.

May 9, 1877. Chilian Earthquake Sea-waves.—The epicentre of the earthquake lay about 90 miles south-west of Iquique. The sea-waves were observed at different places along 2200 miles of the South American Coast. They swept across the Pacific and were recorded in New Zealand (5600 miles), New South Wales (6800 miles), and so far as Japan (8900 miles).

May 9, 1893. Early Season.—The spring and early summer of 1893 were among the earliest on record in

the British Isles. "Stimulated by continued heat, vegetation of all kinds was forced on rapidly, and without any check worth mentioning, into leaf and flower, and in some cases into fruit, long in advance of its usual time. Even in parts of Scotland strawberries were gathered in May and new potatoes and peas ready for use." (Report on the Phenological Observations, p. 127.) In south-west England the greater bindweed was in flower on May 9, five weeks in advance of its usual date, and even in western Scotland it was only two days later. The foliage of trees was abundant and well developed, flowering trees and shrubs bloomed with extraordinary freedom. In the fields and hedgerows flowers were abundant and followed each other in rapid succession, but the dry and forcing weather weakened the plants themselves and they soon faded. Insects were very numerous, and the swarms of wasps amounted to a plague. The earliness of the seasons was maintained into the autumn, and the harvests began everywhere at almost unprecedented dates, but were very poor over most of England.

May 9, 1919. Cloud formed by Aeroplane.—During a high flight over Germany, the aviator observed that at a height of 26,000 feet a streak of cloud formed behind him. This cloud attained a length of about 40 miles, then gradually spread and developed into a typical cirro-cumulus cloud, about 3000 feet broad. Similar phenomena were repeated on May 11. On both days the weather conditions were inclined to thunder, and it seems probable that the exhaust gases supplied condensation nuclei to the air, thus giving the necessary stimulus to cloud formation.

May 10, 1879. Meteorite.—During the afternoon a great meteorite fell and burst near Estherville in Iowa. The largest fragment recovered weighed more than 400 pounds. This is the largest meteorite in America which has been actually observed to fall.

Societies and Academies.

LONDON.

Geological Society, Mar. 26.—**W. Campbell Smith**: A classification of some rhyolites, trachytes, and phonolites from part of Kenya Colony, with a note on some associated basaltic rocks. Comparison of specimens collected on two expeditions by Prof. J. W. Gregory in 1893 and 1919, previously described by Dr. G. T. Prior (1903) and Miss A. T. Neilson (1921), supported by some new analyses, has led to a revision of the nomenclature.—**T. N. George**: *Ambocœlia* Hall and certain similar British Spiriferidæ. The British forms do not exhibit the features emphasised by Hall in his description of *Ambocœlia*; in particular, they differ in the surface-ornament, in the cardinal process, and in the musculature of the dorsal valve. Two new genera, distinguished one from the other by details of ornament and cardinal area, are therefore established for their reception, and it is proposed to create a new subfamily for the reception of *Ambocœlia* and the new genera. The later portion of the paper consists of a detailed description of the British species from the Devonian, Carboniferous, and Permian systems. Some of these are new.

Linnean Society, April 3.—**H. Lister**: Observations on the comparative morphology of the protozoan fauna found in the paunch and reticulum of ruminants. The actual species vary with the geograpical environment of the host. By using suitable culture media and a specially designed microculture incubator, they have, during the present investigation, been kept alive for longer periods than hitherto. The cultures have shown that the bacteria inevitably introduced with the protozoa render the medium acid, and that this proves fatal to them.—**H. S. Holden**: Some wound reactions in *Ankyropteris corrugata*. The tissues of the fossil fern *Ankyropteris corrugata* show well-defined wound reactions. In the root these consist of irregularly disposed wedges of meristem and are confined to the cortex. In the stem, wounds usually take the form of irregular cortical fissures bordered on either side by a strip of meristem. In the petiole, where the wound is superficial, a pad of healing meristem is developed, but, where it is deep-seated, the vascular tissues may be involved.—**J. M. Cowan**: Botanical exploration through North-West Persia. A brief survey of the vegetation of Iraq and North-West Persia observed on a tour made on behalf of the John Innes Horticultural Institution and Kew Gardens.

Optical Society, April 10.—**T. Smith**: Charts for simple two and three thin lens problems. A variety of charts can be drawn, each of which furnishes complete first-order information on systems constructed from two or three thin lenses.—**M. O. Pelton**: The lustre of textile fibres is due to a geometrical property of transparent cylindrical filaments with polished surfaces. Some of the factors, notably double refraction and diffraction, which might affect lustre, are discussed, and a method is suggested for measuring lustre based on the high lights visible on a curved lustrous surface.—**W. D. Wright**: A redetermination of the mixture curves of the spectrum. The paper describes a method that has been developed for calculating the sensation curves and mixture curves from an average set of trichromatic coefficients and the standard luminosity curve, without recourse to any further experimental data. A complete table of colour mixture data is given. The practical value of different methods of colorimetry and the most desirable primaries for use as reference standards are briefly discussed.

DUBLIN.

Royal Society, April 2.—**J. Joly**: The application of gamma radiation to deep-seated tumours. The applicator operates on the principle of a pseudo focus, formed by the convergence of two inclined gamma ray beams intersecting at the tumour. The beams are kept in continual rotation round a vertical axis, while at the same time they are carried along a path determined by a template which has been derived from X-ray exploration of the tumour. The movements are controlled by clockwork, and the whole applicator, in certain cases, may be worn by the patient without serious inconvenience. The γ-radiation may be derived from radon tubes or radium tubes such as are used in needle radio-therapy; some twenty-five or thirty such tubes being packed into each radiator.—**J. Reilly** and **D. T. McSweeney**: A study of the polysaccharides (Pt. 2).

GENEVA.

Society of Physics and Natural History, Feb. 6.—**J. Briquet**: The number of carpels in the flowers of *Campanula*. The character of the trimery and pentamery of the gynæcium plays an important part in the systematics of this genus. Now the author has observed that both these arrangements occur in the flowers of *Campanula Medium*. It is therefore necessary to review carefully the behaviour of various species and to modify the diagnoses and analytical tests.—**J. Briquet**: The carpology of the genus *Mantisalca* Cass. The author's studies have proved that the genus *Mantisalca* has been erroneously joined to the genus *Centaurea*.—**E. Briner, J. P. Lugrin**, and **R. Monnier**: The action of nitrogen peroxide and of

sulphur dioxide on lime, calcium carbonate and calcium phosphate. The study of these reactions has been undertaken methodically with the aid of the technique utilised in the laboratory for work on gases, and it has led to the proof of the attack, in the absence of water, of calcium carbonate by nitrogen peroxide and by sulphur dioxide. The reactions differ from those taking place in the presence of water.—**L. Duparc** and **L. Galopin**: The phenocrystals and microlites of the plagioclases of the Abyssinian basalts. The authors have recognised six types of rocks, aphyric, porphyric felspar, augitic, porphyric, doleritic or ophitic, and finally a tokeite type. In the porphyric types the microlites of the mass are more acid than the phenocrystals. A difference in the same direction but to a less extent exists also in the augitic and ophitic types.—**L. Duparc** and **Ch. Wakker**: The auriferous layers of St. Yrieix. The authors have studied several deposits of the region now being worked. Nearly everywhere traces of workings are found dating from the Roman occupation. The auriferous quartz is always found associated with granulites and pegmatites traversing and penetrating the schists. At Cheni the auriferous quartz forms veins of variable thickness reaching sometimes two to three metres. It is also in the form of auriferous quartz veins that it is found at Champvert, la Tournerie, and la Fagassière.—**G. Ladame**: The metalliferous deposits of Mt. Chemin, Valais. The author distinguishes three groups of deposits, (1) magnetite, (2) marbles, (3) fluorspar and galena. The magnetite appears to have been worked from the time of the Roman occupation. Its mode of formation cannot be specified. On the other hand, the fluorspar and the galena are clearly in veins.

ROME.

Royal National Academy of the Lincei, Dec. 15.—**S. Franchi**: The Franco-Italian border between the Colle del Piccolo S. Bernardo and the Colle della Seigne, to the south of Mont Blanc.—**E. Raimondi**: The geodetic curvature on a surface, and Liouville's formula.—**L. Laboccetta**: General method for the construction of Fourier's 'separate functions' and of De La Vallée Poussin's 'characteristic functions'.—**G. Mazzone-Sangiorgi**: The first elements of a new general theory for the motion of waters and other fluids (2). Seven different cases of jets are considered, the results obtained in each instance being in complete accord with those derived from the author's theory.—**A. de Mira Fernandes**: Odographic systems.—**A. Tonolo**: Integration of the Maxwell-Hertz electromagnetic equations. The author's method of integration, published in 1910, is extended to the more general form of the Maxwell-Hertz equations of the electrodynamics of bodies at rest. The resulting formulæ, although complex, are simpler than those obtained by Tedone in 1916.—**M. Lecat**: Relations between the behaviour of a binary system on distillation and the course of the temperature–vapour pressure curves of the components. The conditions for determining if any particular binary system is or is not azeotropic are considered.—**Remo de Fazi** and **F. Monforte**: New reaction of aldehydes (4). Acenaphthene and cyclic aldehydes do not form condensation products, although, in presence of concentrated sulphuric acid, they give a characteristic colour reaction. If the acenaphthene is converted into acenaphthenone, this condenses with cyclic aldehydes to products which also give the colour reaction general for those aldehydes. Guglialmelli and Delmon's view that the coloration is due to condensation products of fluorene is not in accordance with the experimental results.—**A. Cavinato**: New investigations on euclase. Euclase from Valle Aurina. Analysis of this euclase gives results in agreement with the molecular ratios, $SiO_2 : R_2O_3 : RO : H_2O = 1{\cdot}98 : 1 : 2 : 1$, and, if constituents present in small proportions are neglected, the formula becomes $HBeAlSiO_5$. Thus the accepted formula, based on Damour's analysis, is confirmed, and that given by Rammelsberg disproved.—**Giulia Martinez**: Basalt from Cucchiara Zeppara near Guspini (Sardinia).—**G. Pupilli**: Periodic respiration caused by sympathicotomy.—**S. Ranzi**: Experimental embryology of the cyclostomes.—**P. Pasquini**: Nervous relations of the transplanted eye and olfactory organ in axolotl embryos.—**G. Pollacci** and **Maria Bergamaschi**: Demonstration, by means of dimethylhydroresorcinol, of the formation of formaldehyde in living plants during chlorophyllic photosynthesis. Experiments made with water plants in presence of dimethyldihydroresorcinol ('dimedon') demonstrate the formation of formaldehyde when the conditions necessary for chlorophyllic synthesis, namely, presence of carbon dioxide and chlorophyll and action of light, are fulfilled. The dimedon has a narcotic effect on the plants, but does not kill them, since after the experiment the plants are still capable of assimilation.—**R. Savelli** and **N. Soster**: Apogamocarpy in *Cucurbita pepo* and *Cucurbita moschata*.—**L. S. Da Rios**: Suction fans and rings.

VIENNA.

Academy of Sciences, Jan. 23.—**K. Morsch**: The action of chloral hydrate and hydroxylamine on the isomeric phenylene diamines.—**F. Hölzl**, **R. Kügerl**, and **K. Rokitansky**: The mobility of some ions containing iron (1). Comparison of simple and complex iron salts.—**G. T. Whyburn**: (1) Derived continua dividing the plane.—(2) A theorem on derived continua of the plane connected in detail.—(3) Connected quantities completely dissectible.—(4) Undivided elemental quantities from connected point quantities.—**L. Kober**: The distribution of masses on the earth's surface. The ratio of the surfaces of continents to oceans is about 1 to $2\frac{1}{2}$. The ratio of the densities of land to sea is about $2\frac{1}{2}$ to 1. Surface and density of continents and oceans are reciprocally proportional. Assuming heights of continents equal to depths of oceans, then the weight of the continents is equal to the weight of the oceans.—**F. Machatschek**: Remarks on the question of the distribution of masses on the earth's surface. The ratios just quoted are changed if the continental shelf is reckoned with the continents.

Jan. 30.—**A. Sommerfeld**: The paramagnetic forces of the rare earths.—**E. Beutel** and **A. Kutzelnigg**: Contributions to analysis of luminescence (1).—**G. Lock**: Derivatives of phenyl-ether (1). Mono-nitro, amino- and oxy-derivatives.—**K. Beaucourt**: Constituents of resin (2). Dehydrogenation of boswellinic acid. By the action of selenium or palladium on incense resin, a mixture of aromatic hydrocarbons is produced.—**T. Pintner**: *Tetrarhynchus* from Pacific Grove, Cal., U.S.A.—**H. Hornich**: The characteristics of connexion *im grossen* and *im kleinen*.—**A. Rollett** and **O. Schneider**: Resins and resinous substances (7). Tolubalsam.—**F. Morton**: Report on a botanical expedition to Guatemala, 1928–29.

Feb. 6.—**R. Janoschek**: Strata sequence and stratification of the Miocene of Ritzing, Burgenland.—**O. Kühn**: The Danic stage in the Alps and Carpathians.—**L. Waagen**: The geological structure of the Eichkogel near Rein, not far from Graz.—**O. Gugenberger**: The Cardita strata in Middle Carinthia and their fauna (1). Brachiopoda.

Feb. 13.—**K. Menger**: The introduction of complex numbers into general metrics.—**P. Gross** and **K. Schwarz**: Salting out.—**K. Federhofer**: Kinetostatics of systems moving on surfaces.

Official Publications Received.

BRITISH.

Reports of the Imperial Economic Committee. Fourteenth Report: A Survey of the Trade in Rubber Manufactured Goods. Pp. 119. (London: H.M. Stationery Office.) 6*d*. net.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 59, July to December 1929. Pp. xii+273-531+17+48. (London.) 15*s*. net.

Journal of the Indian Institute of Science. Vol. 13A, Part 2: Formation of Heterocyclic Compounds from Ethyl Carbethoxythiocarbamate. By Praphulla Chandra Guha and Shanker Rao A. Saletore. Pp. 11-20. 10 annas. Vol. 13A, Part 3: Petrol-Water Emulsions. By C. Varadhan and H. E. Watson. Pp. 21-30. 12 annas. Vol. 13A, Part 4: i. Studies on Dextrins, Part 1; Action of Amylase from Cholam (*Sorghum vulgare*) on Potato Starch, by Vinayak Narayan Patwardhan; ii. Amylase from Ragi (*Eleusine coracana*), by V. N. Patwardhan and Nuggehali Narayana. Pp. 31-41. 12 annas. (Bangalore.)

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1929. Pp. 10. (Salisbury, S.R.)

The Proceedings of the Physical Society. Vol. 42, Part 3, No. 233, April 15. Pp. iv+153-292. (London.) 7*s*. net.

Canada. Department of Mines: Mines Branch. Mica. By H. S. Spence. (No. 701.) Pp. ix+142+21 plates. (Ottawa: F. A. Acland.) 30 cents.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1268 (Ae. 414): Experiments relating to the Flow in the Boundary Layer of an Airship Model. By L. F. G. Simmons. (T. 2768.) Pp. 7+6 plates. (London: H.M. Stationery Office.) 6*d*. net.

Journal of the Royal Microscopical Society. Series 3, Vol. 50, Part 1, March. Pp. xvi+160. (London.) 10*s*. net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 14, 1929. Pp. 775. (London.) 7*s*. 6*d*. to Members, 12*s*. 6*d*. to non-Members.

Memoirs of the Geological Survey of India. Vol. 54: The Geology of North Singhbhum, including parts of Ranchi and Manbhum Districts. By Dr. J. A. Dunn. Pp. ii+iii+166+xxvii. (Calcutta: Government of India Central Publication Branch.) 12.4 rupees; 20*s*.

Report of the Kodaikanal Observatory for the Year 1929. Pp. 4. (Calcutta: Government of India Central Publication Branch.) 6 annas.

The Journal of the Institution of Electrical Engineers. Vol. 68, No. 400, April. Pp. 413-524+xxviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Imperial Institute. Annual Report 1929 by the Director, Lieut.-Gen. Sir William Furse, to the Board of Directors. (Meeting 9th April 1930.) Pp. 56+4 plates. (London.)

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 1, No. 2, September 1929. Compiled by Agnes Elisabeth Glennie. Pp. iv+154. (London: H.M. Stationery Office.) 2*s*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 37: The Application of Gamma Radiation to Deep-seated Tumours. By Dr. J. Joly. Pp. 447-450. 6*d*. Vol. 19 (N.S.), No. 39: Some Geochemical Applications of Measurements of Hydrogen Ion Concentration. By Dr. W. R. G. Atkins. Pp. 455-460. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Legislative Assembly, New South Wales. Report of the Director-General of Public Health, New South Wales, for the Year 1928, presented by the Minister for Health. Pp. v+126. (Sydney: Alfred James Kent.)

New South Wales. Department of Mines: Geological Survey. Mineral Researches No. 35: The Yerranderie Silver Field. By L. F. Harper. Pp. 63+26 plates. (Sydney: Alfred James Kent.)

Collected Papers from the Science Laboratories of the University of Melbourne, 1910-1928. Vol. 3. 87 papers. Vol. 4. 47 papers. Vol. 5. 42 papers. Vol. 6. 62 papers. (Melbourne.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 3, March. Abstracts Nos. 458-670. Pp. 73-112. (London: H.M. Stationery Office.) 9*d*. net.

Department of Scientific and Industrial Research. Second Report of the Fabrics Co-ordination Research Committee. Pp. viii+180. (London: H.M. Stationery Office.) 5*s*. net.

FOREIGN.

Publications of the United States Naval Observatory. Second Series, Vol. 12. Pp. ix+592+15 plates. (Washington, D.C.: Government Printing Office.)

Bergens Museum. Årsberetning, 1928-1929. Pp. 114. Bergens Museums Årbok 1929. Naturvidenskapelig rekke. Heft 2. Pp. 10+22+6+4+8+35+7+46+92+4. Bergens Museums Årbok 1930. Naturvidenskapelig rekke. Heft 1. Pp. 179. (Bergen: A.-S. John Griegs Boktrykkeri.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 5, No. 1, Avril. Pp. 137. (Copenhague: Andr. Fred. Høst et fils.)

Bulletin of the American Museum of Natural History. Vol. 61, Art. 1: Pug-Headedness in the Striped Sea Bass, *Roccus lineatus*, and in other related Fishes. By E. W. Gudger. Pp. 19+3 plates. (New York.)

The Observatory of Zi-ka-wei: Fifty Years of Scientific Work. By the Rev. P. Lejay. Pp. 36. (Zi-ka-wei.)

Japanese Journal of Physics: Transactions and Abstracts. Vol. 5, No. 3. Pp. 103-137+25-52+ii. Vol. 5, No. 4. Pp. 139-160+53-63+vi. (Tokyo: National Research Council of Japan.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 194: The Use of Peat in the Greenhouse. By Alex Laurie. Pp. 28. Circular Bulletin No. 129: Results of a Long Time Mineral Feeding Experiment with Dairy Cattle. By C. F. Huffman and O. E. Reed. Pp. 11. (East Lansing, Mich.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 26, Part 5: Notes on certain Type Specimens of American Asteraceae in European Herbaria. By S. F. Blake. Pp. iii+227-263+v-ix. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 76, Art. 7: *Briarosaccus callosus*, a new Genus and new Species of a Rhizocephalan Parasite of *Lithodes agassizii* Smith. By H. Boschma. (No. 2804.) Pp. 8. Vol. 77, Art. 7: The Caudal Molt of certain Coraciiform, Coliiform and Piciform Birds. By Herbert Friedmann. (No. 2830.) Pp. 6. (Washington, D.C.: Government Printing Office).

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. Pp. 46 (24 planches). (Copenhague: Andr. Fred. Høst et fils.) 4 kr.

Proceedings of the Imperial Academy. Vol. 6, No. 1, January. Pp. iii+25. Vol. 6, No. 2, February. Pp. v-viii+27-92. (Tokyo.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 58: On the Resistance experienced by a Cylinder moving in a Channel of Finite Breadth. By Susumu Tomotika. Pp. 101-142. (Tôkyô: Koseikai Publishing House.) 0.44 yen.

Académie Tchèque des Sciences (Česká Akademie Věd a Umění). Bulletin International. Résumés des travaux présentés. Classe des sciences mathématiques, naturelles et de la médecine. Année 28 (1927). Pp. vi+450. (Prague.)

United States Department of Agriculture. Technical Bulletin No. 178: Properties of Soils which influence Soil Erosion. By H. E. Middleton. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents.

American Geographical Society. Special Publication No. 11: Brief History of Polar Exploration since the Introduction of Flying. By W. L. G. Joerg. To accompany a Physical Map of the Arctic and a Bathymetric Map of the Antarctic. Pp. v+50+2 maps. (New York.) 5 dollars.

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 25: The Social Philosophy of Pensions, with a Review of existing Pension Systems for Professional Groups. By Henry S. Pritchett. Pp. iv+85. (New York City.) Free.

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 4, Avril. Pp. 161-208. (Prague; Regis Societas Scientiarum Bohemica.)

Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland. Band 2: Meteorologie und Geophysik. Lief. 2: Untersuchungen über die Wolkenbildung auf dem Pårtetjåkko im August 1928 nebst einer erweiterten Untersuchung der Tropfengruppen. Von Hilding Köhler. Pp. 77-128. (Stockholm: C. E. Fritze; Berlin: R. Friedländer und Sohn.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 28, Part 1: Ein Beitrag zur Kenntnis der Gattung *Rhizopus*, I. Von Yoshihiko Yamamoto. Pp. 101+4 Tafeln. (Tokyo: Maruzen Co., Ltd.)

Division of Fish and Game of California. Fish Bulletin No. 20: The Commercial Fish Catch of California for the Year 1928. By the Staff of the Bureau of Commercial Fisheries. Pp. 110. (Sacramento: California State Printing Office.)

United States Department of the Interior: Office of Education. Bulletin, 1929, No. 31: Legal Education 1925-1928. By Alfred Z. Reed. Pp. 22. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the California Academy of Science, Fourth Series. Vol. 18, No. 17 and No. 18: Report of the President of the Academy for the Year 1929, by C. E. Grunsky; Report of the Director of the Museum and of the Aquarium for the Year 1929, by Barton Warren Evermann. Pp. 531-586. (San Francisco.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Genotypes of the Scrophulariaceae in the first edition of Linné's "Species Plantarum". By Francis W. Pennell. Pp. 9-26. The Freshwater Fishes obtained by the Gray African Expedition, 1929; with Notes on other Species in the Academy Collection. By Henry W. Fowler. Pp. 27-83. The East African Forms of the Bare-Throated Francolin, *Pternistis cranchii*. By W. Wedgwood Bowen. Pp. 85-87. (Philadelphia.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 6: The Past Climate of the North Polar Region. By Edward W. Berry. (Publication 3061.) Pp. 29. (Washington, D.C.: Smithsonian Institution.)

CATALOGUE.

The Nickel Bulletin. Vol. 3, No. 4, April. Pp. 105-136. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

FRIDAY, MAY 2.

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting), at 10.30 A.M.—Papers by Prof. M. Sourdille and G. J. Jenkins.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—The Earth's Bodily Tide. Dr. L. Rosenhead, Dr. H. Jeffreys, and J. C. Dobbie. Chairman, Prof. L. N. G. Filon.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Annual General Meeting.

ROYAL SANITARY INSTITUTE (at Town Hall, Tunbridge Wells), at 5.30.—Dr. F. C. Linton and others: Discussion on The Maternity Home as a Health Asset.—H. T. Taylor and others: Discussion on Can the Slum be Abolished?

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—C. W. Marshall: The Metering Arrangements for the 'Grid' Transmission System in Great Britain (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Major A. W. Farrer: Empire Free Trade and the Engineer.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—A. A. Miller and J. S. Turner: The Lower Carboniferous Succession along the Dent Fault and the Yoredale Beds of the Shap District.—R. G. S. Hudson: The Carboniferous of the Craven Reef Belt: The Namurian Unconformity at Scaleber, Nr. Settle.

FARADAY SOCIETY (at Chemical Society), at 8.—Prof. G. Wiegner: On Coagulation (Lecture).

PHILOLOGICAL SOCIETY (at University College), at 8. — Anniversary Meeting.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (Annual General Meeting), at 8.30.—Dr. R. J. Clausen: Ethylene Anæsthesia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9. — H. E. Wimperis: A Study of the Phenomenon of Spin in Airplanes.

MONDAY, MAY 5.

ROYAL SOCIETY, EDINBURGH, at 4.30.—Dr. R. Crookall: On Some Curious Fossils from the Downtonian and Lower Old Red Sandstone of Scotland.—A. C. Stephen: Studies on the Scottish Marine Fauna. Additional Observations on the Fauna of the Sandy and Muddy Areas of the Tidal Zone.—Dr. E. A. T. Nicol: The Feeding Mechanism, Formation of the Tube, and Physiology of Digestion in *Sabella pavonina*.—Dr. R. A. Fisher: The Distribution of Gene Ratios for Rare Mutations. —F. E. Allan: The General Form of the Orthogonal Polynomials for Simple Series with Proofs of their Simple Properties.

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

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Anatomy of Fossil Man: *Homo Gardarensis:* discovered in Greenland and recently described by Prof. Fr. C. C. Hansen of Copenhagen.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—H. R. Lintern: The Methods of Testing the Lubricating Values of Oils, Greases, etc.

BRITISH PSYCHOLOGICAL SOCIETY (Joint Meeting of the Æsthetic and Education Sections) (at Bedford College), at 6.—W. Platt: The Child's Innate Sense of Music.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Prof. G. T. Morgan: Observations on the Condensations between Formaldehyde and Aromatic Compounds.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Major R. W. G. Hingston: The Oxford Expedition to British Guiana.

TUESDAY, MAY 6.

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

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. S. M. Manton: Notes on the Habits and Feeding Mechanisms of *Anaspides* and *Paranaspides* (Crustacea, Syncarida). — Col. A. E. Hamerton: Remarks on Trypanosomiasis in Relation to Man and Beast in Africa.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. R. V. Southwell: Aeronautical Progress, 1914–1930 (James Forrest Lecture).

IRON AND STEEL INSTITUTE (at Chamber of Commerce, Birmingham), at 7.—J. A. Jones: Chromium-Copper Structural Steels.—M. L. Becker: Carburising and Graphitising Reactions between Iron-Carbon Alloys, Carbon Monoxide and Carbon Dioxide.—A. L. Norbury and E. Morgan: The Effect of Melting Conditions of the Microstructure and Mechanical Strength of Grey Cast Irons containing Various Amounts of Carbon and Silicon.—R. Whitfield: Single-Sheet or Thin-Pack Normalising, or Heat Treatment *versus* Box-Annealing of Sheets.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7.—T. Austin: Luminous Traffic Signals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. A. Hall: Some Problems of the Printing Process.

TELEVISION SOCIETY (at University College), at 8.—R. Neville-Gray: Liquid Photo-electric Cells (Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30. — Major Trevor: Great Zimbabwe.

WEDNESDAY, MAY 7.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Annual General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Anatomy of Fossil Man: The Mammoth Hunters of Moravia and their Relationship to other Ancient Races of Europe.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—P. P. Eckersley and N. Ashbridge: A Wireless Broadcasting Transmitting Station for Dual Programme Service.

SOCIETY OF GLASS TECHNOLOGY (London Section) (at Holophane, Ltd., Elverton Street, S.W.), at 7.30.—Discussion on The Measurement of Temperature in Furnaces.

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8.—Major F. A. Freeth: The Influence of Technique on Research (May Lecture).

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. L. H. Lampitt, E. B. Hughes, and H. S. Rooke: The Diastatic Activity of Honey.—Dr. W. R. Schoeller: A New Method for the Separation of Titanium from Zirconium and Hafnium.—E. R. Bolton and K. A. Williams: The Composition and Polymerisation of Chinese Wood (Tung) Oil.

ROYAL SOCIETY OF ARTS, at 8.—S. K. Ratcliffe: National Parks.

THURSDAY, MAY 8.

CHEMICAL SOCIETY (at Salters' Hall, St. Swithin's Lane, E.C.4), at 5.30.—Prof. Niels Bohr: Chemistry and the Quantum Theory (Faraday Lecture).

CHILD-STUDY SOCIETY (Annual Meeting) (at Royal Sanitary Institute), at 6.—T. J. Faithfull: The Re-Education of the Difficult Child.

BRITISH INSTITUTE OF RADIOLOGY (in Reid-Knox Memorial Hall), at 6.—Prof. J. Murdoch: The Problem of Dosage in Radium Therapy (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—L. D. Talamon: The Hypersensitisation of Colour Plates.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—F. Twyman and Dr. F. Simeon: The Wedge Sector for Quantitative Spectrum Analysis.—E. T. Hanson: On the Diffraction of Light by a Slit.—Demonstration by E. F. Fincham of a New Ophthalmoscope.

FRIDAY, MAY 9.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Dr. D. Clouston: The Report of the Royal Commission on Agriculture.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. J. S. Plaskett: The High Temperature Stars (George Darwin Lecture). — Radcliffe Observatory, Oxford: Positions of the New Planet from Photographs taken at the Radcliffe Observatory.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Anatomy of Fossil Man: The Races represented by Fossil Remains discovered by Miss Dorothy Garrod in the Caves of Palestine.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—E. J. Williams: (*a*) The Inductance of Electromotive Forces in a Moving Liquid by a Magnetic Field; and their Application to the Investigation of the Flow of Liquids; (*b*) The Motion of a Liquid in an Enclosed Space.—E. Simeon: The Generation of Sound by the Siren Principle.—Demonstration by Dr. A. G. Milligan of the Regional Absorption of Dyes by Crystals of Alum and Rochelle Salt.

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

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

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section) (Annual General Meeting), at 6.15.—J. W. Moffatt and J. C. Emerson: The Rotary Automatic Telephone System.

BEDSON CLUB (Armstrong College, Newcastle-upon-Tyne), at 6.30.—Prof. J. B. Cohen: Synthetic Drugs (Bedson Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Criterion Restaurant, Piccadilly), at 6.45. — Sir Frederic L. Nathan and others: Discussion on The International Abstracting and Classifying of Scientific Literature.—Dr. H. Levinstein: Chemistry House—the Present Position.—H. J. Pooley: The Jubilee Meeting of the Society.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9. — Prof. J. Garstang: Archæology and Bible History.

ROYAL SOCIETY OF MEDICINE, at 9.—Prof. J. Murdoch: Radium Treatment of Cancer (Lecture).

SATURDAY, MAY 10.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (at Torquay).

PHYSIOLOGICAL SOCIETY (in Physiology Department, Cambridge).

SUNDAY, MAY 11.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (at Torquay).

PUBLIC LECTURES.

MONDAY, MAY 5.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. Graham Wallas: Physical and Social Science (Huxley Lecture).

UNIVERSITY COLLEGE, at 5.30.—Prof. J. Macmurray: The Conception of a Personal Universe: the Problem of Modern Philosophy.

TUESDAY, MAY 6.

GRESHAM COLLEGE, at 6.—A. R. Hinks: The New Planet beyond Neptune. (Succeeding Lectures on May 7, 8, and 9.)

WEDNESDAY, MAY 7.

KING'S COLLEGE, at 5.—Prof. J. A. Gunn: Pharmacological Reactions of Involuntary Muscle. (Succeeding Lectures on May 8 and 9.)

UNIVERSITY COLLEGE, at 5.30.—Prof. F. J. Cole: The Early History of Generation and Comparative Anatomy. (Succeeding Lectures on May 8, 14, 15, 21, and 22.)

THURSDAY, May 8.

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON, at 5.—Dr. W. E. Gye: The Action of Antiseptics on the Virus of Filtrable Tumours.

BIRKBECK COLLEGE, at 8.—Prof. J. Graham Kerr: A Biologist on the Training of the Citizen.

FRIDAY, MAY 9.

BIRKBECK COLLEGE, at 8.—Prof. J. Graham Kerr: Primitive Fish and the Light they cast upon the Structure of Vertebrates.

ANNUAL MEETING.

MAY 1 AND 2.

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers).

Friday, May 2, at 10 A.M.—Announcement of Award of the Andrew Carnegie Research Scholarships for 1930–31. Announcement of Award of the Williams Prize to W. E. Simons.

Dr. W. Rosenhain and C. H. M. Jenkins: Some Alloys for Use at High Temperatures. Nickel-Chromium and Complex Iron-Nickel-Chromium Alloys. Part I.—C. H. M. Jenkins, H. J. Tapsell, C. R. Austin, and W. P. Rees: Part II.

J. L. Haughton and M. L. Becker: Alloys of Iron Research. Part IX. The Constitution of the Alloys of Iron with Silicon.

M. L. Becker: Carburising and Graphitising Reactions between Iron-Carbon Alloys, Carbon Monoxide, and Carbon Dioxide.

A. L. Norbury and E. Morgan: The Effect of Melting Conditions on the Microstructure and Mechanical Strength of Grey Cast Irons containing Various Amounts of Carbon and Silicon.

A. R. Page and J. H. Partridge: The Properties of some Steels containing Chromium.

D. Brownlie: The History of the Cementation Process of Steel Manufacture. Part I.—Baron de Laveleye: Part II.

S. Maita: The Corner Ghost in Steel Ingots.

CONGRESS.

MAY 19, 20, AND 21.

INTERNATIONAL CONGRESS ON MALARIA (at Algiers).