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The Economic Position of Backward Peoples.

WHEN the British Association visited South Africa in 1905, the country was still suffering from the effects of the Boer War. Of the many problems which had demanded solution, the most acute had been that of labour. In the efforts to restore social and economic equilibrium, the mining industry had made demands upon the native labour supply which it had been unable to meet, and after strenuous opposition and an acrimonious exchange of opinion from opposing camps, not only in South Africa but also in Great Britain, a solution had been sought by the introduction of Chinese labour —a solution which failed, perhaps happily for the future of the country. The difficulties of the situation were not relieved by the settlement in South Africa of large numbers of natives of India, who indeed both at that time and afterwards added to the gravity of the situation in further complicating the relations of the white and coloured populations both politically and economically.

In the period which has elapsed between the first and second visits of the British Association to South Africa, there have been many changes, but fundamentally the situation in regard to the racial question remains unaltered. Notwithstanding the attempts which have been made to secure some *modus vivendi* between white and black which will secure for the latter opportunity for social, economic, and political development with due regard to the interests of South Africa as predominantly a white man's country, the problem has still to be solved.

On one side the native question in South Africa has naturally much in common with the situation that arises elsewhere whenever a backward people is brought into contact with European civilisation. The exploitation of the resources of the country brings a demand for cheap and plentiful labour which the native is induced to satisfy by the acquisition of new desires for the objects, material and other, which are brought within his reach by European culture. These are not necessarily in themselves entirely harmful, although experience in the past has shown that more often than not the result of the contact has been disastrous. The provision of facilities for a higher standard of living, an improved system of sanitation and hygiene, a medical service, and opportunities for education, are now generally recognised as normal activities of the administration in our dependencies which have any appreciable native population.

The practice of earlier days ignored the interests of the natives, leaving them more or less at the mercy of the exploiting trader or settler. It made little or no effort to protect them against the vices of civilisation except in so far as was necessary to safeguard the white population. On the other hand, the modern type of humanitarian administration is not without its drawbacks. Too often it leads to the disintegration of native tribal organisation and the breaking up of the indigenous moral and religious code. It is one of the problems of the administrator to provide against the dangers of this disintegration. In any case, it can no longer be regarded as an adequate solution that the native should remain a hewer of wood and drawer of water under the white man's control, however benevolent; nor does the provision of facilities for education, even technical education, along the lines of our civilisation, meet the needs of the case, as was once thought. Development must be along lines concordant with native culture.

In most tropical countries, climatic conditions make it inevitable that the European should be only a small and transient element in the population. Yet a day must come when the development of tropical countries of suitable soil will no longer be a question of the individual gain of a pioneer settler, but the outcome of a world-wide necessity created by the normal increase in world population. This is a fundamental factor in the situation which ultimately must have a decisive effect in shaping the destiny of the backward peoples. On a long view, reservations or any other means of segregation can at best only be regarded as temporary protective measures for educative purposes; in the end, native populations, to use a convenient conventional term, must come under the full play of economic forces and enter into competition with the rest of the world as productive units under penalty of extinction. It is both a moral and a political duty, in the broader sense, incumbent upon the advanced peoples who are in contact with backward races, that they should prepare them for the ordeal. They must so guide their development that, while they are guarded from the effects of the premature breaking up of their own civilisation, they may be trained gradually to take their place in the economic system of the peoples of the world.

The danger of any attempt at premature social and economic development of native populations was one point which was particularly stressed by Mr. Henry Balfour when speaking at a discussion on " The Economic Competition between Advanced and Backward Peoples " which took place at a joint meeting of Sections F (Economics) and H (Anthropology) on July 25 at Cape Town during the recent meeting of the British Association. Though it was intended that the discussion should deal with general principles rather than particular instances, it was inevitable that the difficulties of the situation in South Africa should take a prominent place. Many of these added point to Mr. Balfour's remarks.

In opening the discussion, Prof. H. Clay pointed out that while economic competition between advanced and backward peoples is possible without their being in propinquity, if they are in contact this adds the colour of emotion to the difficulties of the economic competition. Here he placed his finger upon one of the fundamental problems of the situation. Racial antagonism, always acute in such conditions, is emphasised by the colour bar. As he pointed out, backward peoples lack power of direction and, on the whole, take over the simpler processes from the more advanced peoples, freeing the latter for more advanced industries.

Now while it would be possible to point to areas, especially areas such as West Africa in which the white population is relatively small, where this principle, it may be hoped, is leading to the gradual development of native capabilities with a minimum of dislocation, in South Africa, an area with a comparatively long history of white settlement behind it and a large population of detribalised natives, the black comes into competition with the poorer class of white, and tends to displace this class on the economically unsound practice of less pay for coloured labour. It is encouraging from some points of view that among the more skilled coloured labourers some may now earn more than a white. In other words, the black, in the play of political and economic forces, is coming to earn as a producing unit without regard to his colour.

To sum up the discussion in one general impression, it would almost be fair to say that the social and economic problem of South Africa is the poor white rather than the black. Notwithstanding the grave signs of unrest among the natives which have been apparent recently, and especially during the past few weeks, the whole economic situation would appear to be changing slowly in favour of the native population. Yet much ground has to be covered before anything like equilibrium is attained, and whether that is desirable is a social and political question which raises entirely different issues. Here we enter on the field of emotion.

The Locust Problem.

Locusts and Grasshoppers: a Handbook for their Study and Control. By B. P. Uvarov. Pp. xiii + 352 + 10 plates. (London: The Imperial Bureau of Entomology, 1928.) 21*s*. net.

THE entomologist working in the field in remote parts of the world is often seriously handicapped by the lack of literature; he requires a few handy books of reference that he can conveniently carry with him, books to which he can turn in times of need for reliable information concerning the different phases of his work. Such a book is Mr. B. P. Uvarov's "Locusts and Grasshoppers": it is a masterly survey of the whole locust problem by one who has made the subject peculiarly his own. But the author has done far more than to compile a mere survey of the vast and scattered literature that has grown up around the locust problem; he has sifted and sorted his material in a manner that only one with his wide field experience and intimate knowledge of the subject could have done; he has rejected the worthless, indicated the doubtful, and given due prominence to the important and well-established contributions. Furthermore, he has added a running commentary of his own which adds greatly to the value of the book.

Another very valuable feature of the book consists of the many suggestions put forward by the author concerning lines along which further investigations should be undertaken. It comes as a surprise and a shock to one who has long been connected with locust work to find how many serious lacunæ in our knowledge Mr. Uvarov can point out, in spite of the voluminous literature and the many workers busy with the subject in different parts of the world. For example, he indicates clearly how fragmentary and unsatisfactory is our knowledge of the organs of chemical perception (as he calls the organs of smell, taste, etc.) of the Acrididæ; information that is almost essential when one comes to deal with poison baits, spray fluids, reactions to certain stimuli, and so on, is totally wanting. Again, we learn that we know very little indeed about the tympanal organs, or so-called ears of the locusts, and on p. 29 the author says: "The unquestionable importance of the tympanal organs in the behaviour of the *Acrididæ* makes detailed experimental studies of their function vitally necessary." Later on (on p. 34) we read: "The estimation of the period necessary for the development of the embryo is of great practical interest, but the problem has as yet been very insufficiently studied". Again, on page 37: "The data relating to the effect on development of excessive moisture are exceedingly vague and do not permit of any safe conclusion." "Summarising all that has just been said about the influence of external factors on the development of the embryo in the *Acrididæ*, we must admit that our knowledge on this point of great practical importance is very limited and very inexact." "Of practical interest would be an exact experimental study of the emergence of larvæ through layers of earth of various thickness and of varying physical properties, because this would give some indications of the possible effect of various agricultural methods on the emergence of the larvæ" (p. 42). "Only in a relatively small number of species (mainly Russian) have the egg-pods been studied and the subject offers a large field for study by an entomologist" (p. 60). "The problem [of the number of egg-pods laid per female] has not been studied at all in the case of the solitary species" (p. 61). The author points out the urgent need for further studies on the reactions of the insects to different stimuli and says: "The problem presents an almost unexplored field for most interesting observations" (p. 66).

Uvarov insists on the importance of an exhaustive study of the influence of temperature on the behaviour of locusts, "for the body temperature of the insect must be the actual factor determining its physiological activities. Unfortunately, this side of the problem has never been studied, though we shall see later, when discussing the behaviour of swarming locusts, that with it is connected the solution of the main problems of mass migration, as well as those of periodicity of locust invasions" (p. 70).

"The attraction of locusts by certain chemicals [in poisoned baits] has found such an enormous field of practical application that one would naturally expect that the theoretical foundations of such a method had been thoroughly investigated. This, however, is not the case, and our actual knowledge of the influence of various chemicals on the behaviour of the *Acrididæ* is incredibly small" (p. 72). We are told on p. 73 that "we know absolutely nothing concerning the food of the vast majority of species not known as pests". "Unfortunately, there are no data on the chemistry of nutrition in *Acrididæ*." "The very important and interesting question of the quantity of food required for the development of a single individual remains practically unstudied" (p. 75). On p. 108 we are told that "our knowledge of this group [of blister

beetles], as parasites of the *Acrididæ*, is very meagre, the triungulin stage being known for one species only, while the information on the habits and parasitic activities of each species is of a most fragmentary nature. This makes an estimate of the economic importance of these undoubtedly serious enemies of *Acrididæ* practically impossible."

The above quotations, taken at random, will serve to show how necessary and useful is such a survey as that which Mr. Uvarov has given us; besides giving us an adequate summary of the work done and results achieved to date in different parts of the world, he indicates clearly the many lines along which further investigations are needed—a feature of the book that will be greatly appreciated by all entomologists working on the locust problem in the field.

A brief account of the external morphology of the Acrididæ is given in the first chapter of the book, and this is followed by chapters on anatomy and physiology, development and transformations, behaviour, ecology and distribution, natural enemies, periodicity of mass outbreaks, the technique of control, organisation of control; the second half of the book is taken up with full accounts of the different species of locusts and solitary grasshoppers of economic importance that are found in different parts of the world.

The chapter on "Periodicity of Mass Outbreaks" contains a most interesting discussion of the theory of phases of locusts, a theory tentatively put forward as a working hypothesis by Uvarov in 1921. Since this date a great deal of evidence in support of the theory has been gathered, and it promises to have a very important bearing on the whole locust problem. Briefly, the theory is as follows: Various species of gregarious locusts cannot be considered absolutely stable in all their characters, either morphological or biological; on the contrary, there are good reasons for regarding each species as exceedingly plastic and liable to fluctuations in all essential characters. These fluctuations have, of course, certain limitations, but in some cases the bounds are so wide that the extreme forms were often recognised as distinct species. These extreme forms represent what Uvarov calls the 'phases' of the species, one of them being a typical swarming locust in all its biological characteristics, whilst the other is a typical solitary grasshopper. The extreme forms are connected by a continuous series of intermediate ones and no definite dividing line can be drawn.

The fluctuations of specific characters in the direction of one phase or the other usually occur in a given locality simultaneously in all individuals of the species, and this is connected with the periodicity of outbreaks. Overcrowding, for some totally unknown reason or reasons, causes a species to assume the 'swarm phase' characteristics, with the distinct coloration, structure of the pronotum, gregarious instincts, and so on. When the swarm gets thinned out by disease, natural enemies and control measures, the survivors tend to separate and assume the characters of the solitary phase. With the return of favourable conditions, these solitary individuals breed up again rapidly, the gregarious instinct begins to reassert itself, and the swarm phase is once more assumed, maybe after an interval of several years.

Uvarov put forward his theory as a result of his studies of *Locusta migratoria* in the Northern Caucasus, but since then a similar state of affairs has been found to occur with the brown locust of South Africa, the desert locust of the Sudan, and the South American locust, *Schistocerca paranensis*. The whole question is of the utmost interest, not only to the economic entomologist but also to the systematist, the geneticist, the ecologist, and the physiologist; an entirely new and fascinating field of study was opened up when Uvarov showed that *Locusta migratoria* and *Locusta danica* were one and the same species in different 'phases' of its existence.

The two chapters on the technique of control and the organisation of control are very full and suggestive and they are remarkable for the wide practical experience and sound common-sense revealed by the author. On the whole, he seems to be of opinion that there is little future for biological control methods, so far as locusts are concerned; of the artificial methods, he favours the use of poison baits and dry-dusting methods.

Of the second part of the book, dealing with the species of locusts found in different parts of the world, the reviewer is competent to judge only of the chapter on South African locusts. This chapter contains an accurate summary of the position in South Africa and of our knowledge of the brown and red locusts. If the remainder of this section is similar (and there is no reason to doubt it), then the latter half of the book contains the most complete and reliable account of the locusts of the world that is available.

In the last chapter Uvarov pleads convincingly for the organisation of locust research on an international scale. He points out how spasmodic, fragmentary, and unsatisfactory much of the

investigational work has been in the past, due in the main, he thinks, to the suddenness of the outbreaks and the equal suddenness of their disappearance. During the intervals when the locusts are not troublesome, the work is dropped, only to be hastily resumed when the swarms sweep over the country again. The work has suffered severely owing to the lack of continuity and of co-ordination. Uvarov puts forward a very strong plea for the establishment of permanent laboratories where serious, long-period studies of the physiology, ecology, bionomics, etc., of the Acrididæ can be undertaken in accordance with a definite, carefully planned and co-ordinated scheme. It is to be hoped that the authorities concerned will not turn a deaf ear to his convincing arguments.

The book is well printed, well illustrated, and strongly bound. It is undoubtedly one of the most important entomological works that has appeared in recent years, and the author has rendered a most valuable service in undertaking the laborious task and carrying it to such a successful and creditable conclusion. G. H. SKAIFE.

Energy and Heat.

(1) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 8, Teil 1: *Energie- und Wärmeinhalt.* Bearbeitet von Prof. A. Eucken. Pp. xv + 736. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 65 gold marks.

(2) *Lehrbuch der Thermodynamik: für Studierende der Chemie und verwandter Wissenschaften.* Von Prof. A. Magnus. Pp. xii + 288. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 18 gold marks.

(1) THE name of the author of this volume of the Wien-Harms "Handbuch" is a sufficient guarantee of its thorough and authoritative character. The subject matter can be briefly summarised by saying that it includes the whole of the science of energy (internal energy, E,η or U) for unaccelerated bodies and of enthalpy (*Enthalpie, Wärmeinhalt*, heat contents, total heat, $U+pv$), looked at mainly from the experimental point of view, together with enough thermodynamics or gas theory to make the whole intelligible. Allied problems, such as the production of high and low temperatures, properties at high and low pressures, the liquefaction of gases, and heat engineering in general, are dealt with in other volumes of the series.

It is no slight task at the present day to write a treatise on any experimental branch of physics. Not only must a man have knowledge of the work being done at the four or five leading standardising institutions in the world, but also he must be acquainted with multifarious separate publications from almost countless laboratories. The growth of experimental knowledge has led to a revision of theories, and this in its turn has reacted and served as a stimulus for fresh experimental work. This is well illustrated by the section concerning specific heats (p. 410). Our knowledge of their values at low temperatures alone is a new science (p. 40) intimately connected with the theoretical work of Planck, Nernst, Debye, and Eucken himself. Contrast the old and the new again in other cases where theory gives very little help, for example, on the transformation point in the value of C_p for nitrogen (solid) at 36° Abs. (Keesom, Kamerlingh Onnes, Eucken, Clusius), in addition to the melting-point at about 63° Abs. with a continuation of determinations down to 10° Abs. Concerning the speculative nature of the underlying theory, twelve different formulæ are given as having been published since 1913 for the rotational specific heat of hydrogen (gas).

The book is to be commended for a very full discussion of the effect of pressure upon the specific heat of gases. On the theoretical side this might be amplified by recognising that, almost from the beginning, it has been known that van der Waals' a is not independent of temperature. Numerous diagrams are given for various gases; some of the data for these at low temperature being deduced from experiments on the Joule-Kelvin effect (Hansen).

The question of the specific heats of dissociating gases receives attention. This discussion is based on the simple reaction-isochore. Applied to nitrogen peroxide, values of C_p are calculated which tally well with the experimental results of McCollum and of Berthelot and Ogier. Unfortunately, this theory will break down long before the critical region is approached, so that it will be quite inapplicable to steam near the critical point: it provides, therefore, no test of Callendar's recently obtained data. Chapter xi. deals with energy and enthalpy as functions of state (37 pp.); here the isenthalpic throttle effects receive very full treatment. Of the newer matter, the experimental investigations of Hansen (air), Roebuck (air), and of Jenkin and Pye (carbon dioxide) are given with full diagrammatic illustration. Of theoretical values calculated from empirical equations nothing is

given except the determination of volume and temperature at inversion points from van der Waals' equation. A footnote indicates a laborious process by which the corresponding pressures and temperatures can be obtained. It does not seem to have been noticed that it is quite easy to eliminate v from the equations and thus obtain a parabola for the p, T inversion curve. If this is done, interesting properties are revealed which are here passed over in silence.

The rest of the volume is concerned principally with heat changes during transformations of phase (vaporisation, melting, mixing, adsorption, etc.).

The above brief sentences give only a poor idea of the contents of this volume. One of the most important features consists in the excellent illustration by means of diagrams of apparatus and graphs. The whole constitutes one of the most complete treatises on the subject.

(2) The small volume by Prof. A. Magnus is of a totally different kind. It is an elementary book on the subject written mainly for students of chemistry, particular pains being taken not to slur over the mathematical theorems which are involved. With this aim there is a mathematical introduction explaining the processes of partial differentiation and integration. This is all to the good, and it may at once be said that the author has succeeded in giving a very lucid explanation. The remainder of the book consists of the usual applications to simple chemical reactions, terminating with a chapter on Nernst's heat theorem.

One thing it lacks. There are no references to other sources of information except in the final chapter. This detracts from its usefulness. The impression that the student will receive is that the book includes all that is known about chemical thermodynamics. So far as the book goes, however, it can be recommended. The style is simple, and a student beginning to read German would find it a useful text-book on which to practise.

Igneous Rocks.

The Evolution of the Igneous Rocks. By N. L. Bowen. Pp. x + 334. (Princeton: Princeton University Press; London: Oxford University Press, 1928.) 23*s.* net.

IN the middle of the last century much interest was shown in the problem of the genesis of igneous rocks, and especially in the manner of origin of diverse rock-types from a common stock or from a limited number of primitive 'magmas'. The speculations of De Beaumont, Bunsen, Durocher, and others suffered from the lack of any adequate basis either in petrographical knowledge or in chemical theory. Later, with the advent of the microscope in petrology, there came a great accumulation of material on the descriptive side, and meanwhile physical chemistry was making rapid progress.

Prof. Vogt of Trondhjem was the first to attempt a reasoned discussion of the crystallisation of igneous rock-magmas, using primarily a mass of data derived from the technological study of slags. It became apparent, however, that any serious advance must be based upon experiment designed for the purpose and conducted with the precision made possible by modern laboratory methods. This want was at length supplied by the Geophysical Laboratory at Washington, opened in 1907 under the direction of Dr. A. L. Day. Since that time, a staff of skilled chemists has investigated numerous silicate-systems chosen to throw light upon petrogenesis; and in pointing the application of these results, Dr. Bowen, as interpreter between the chemist and the petrologist, has taken a leading part.

The first and larger part of the present work embodies, in the main, the substance of earlier contributions by the author, now restated, sometimes further developed, and shaped into a coherent scheme. All igneous rocks are conceived as being evolved from a normal basaltic magma, differentiation being effected by fractional crystallisation and 'crystal sorting', modified by the intervention of resorption (the 'reaction principle'). The course of evolution may, however, be varied, according as the theoretical fractionation and resorption are actually effective; and such variation should therefore stand in relation with the rate of cooling, and so with the size of the individual masses.

Since crystal sorting may alter to any extent the relative proportions of crystals and liquid, most igneous rocks do not correspond in composition with any liquid, actual or possible, and the clue to evolution is to be sought therefore in the 'liquid lines of descent', not in a simple comparison of bulk-analyses of rocks. Ultrabasic rocks, it is held, can originate only by crystal sorting carried to the extreme. The conditions under which a mass mainly composed of crystals can figure as an intrusion are discussed and illustrated by reference to the peridotite dykes of Skye, which are made the subject of a new and interesting study.

In his instructive discussion of 'assimilation', the author seems to undervalue the importance of the

natural check imposed on this process. A surface of country-rock exposed to an igneous magma must soon become protected by a shield composed of minerals which are in equilibrium with the magma. Most of the results set forth in this part of the book will, however, receive at least a general assent from most petrologists, always excepting irreconcilable advocates of liquation.

The second part, dealing with a variety of subjects, is confessedly of a more speculative character. Of chief interest perhaps is a chapter on the possible manner of origin of certain alkaline rocks. Here it is shown, by the aid of diagrams partly conjectural in their details, how the crystallisation and subsequent resorption of leucite may give rise to residual magmas rich in potash. Much, too, is made to depend upon the rather precarious assumption that the pair anorthite-orthoclase belongs to Roozeboom's type 5 of solid solution. In support of this, the author cites the occasional presence of orthoclase borders round calcic felspars; but he ignores the much more frequent borders round sodic felspars, where the reaction-relation is certainly inadmissible.

The book is well arranged and well printed. It will provide the student with a much-needed guide to the generally accepted principles of petrogenesis; while doctrines which must be regarded as still on their trial are put forward with due reserve and lucidly presented. A. H.

Our Bookshelf.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 7, Teil 1: *Krystallographische und strukturtheoretische Grundbegriffe.* Von Prof. P. Niggli. Pp. xii + 317. 32·50 gold marks. Band 7, Teil 2: *Strukturbestimmung mit Röntgeninterferenzen*, von Dr. H. Ott; *Gittertheorie der festen Körper*, von Prof. Dr. K. F. Herzfeld. Pp. xiii + 433. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.)

PROF. NIGGLI of Zurich, formerly a colleague of Prof. Laue of Munich, is well known as the author of a comprehensive text-book of mineralogy, the second edition of which was recently reviewed in NATURE (vol. 119, p. 595; 1927). This new work forms the first part of the volume on crystallography in the "Handbuch der Experimentalphysik", and deals with the formal and mathematical study of crystal structure. The originality of the author is shown in his theoretical treatment of crystal symmetry, which contains a number of new methods and points of view. He states that his aim has been to elucidate the fundamental principles and to make the theoretical study of the subject practically useful. Although it was not possible to develop in full detail all the mathematical formulæ and relations, valuable tables are included embodying the most important results, and a word of special praise must be given to the numerous diagrams. Each chapter is provided with a short bibliography of the relevant literature, the older papers receiving special attention. The work should be of service both to the student and to the teacher of crystallography.

A new area in the study of crystal structure commenced in 1912 when Prof. Laue and his fellow-workers in the University of Munich were successful in using a crystal as a three-dimensional diffraction grating for X-rays. It is fitting that a member of the same university, Dr. H. Ott, should have been chosen to write the article on the theory and practice of this method of crystal analysis which forms Part 2 of the new volume of the "Handbuch der Experimentalphysik". He has himself done good work in this important branch of physics, including the construction of a metal and glass X-ray tube, the components of which can be exchanged rapidly without the necessity of cementing operations. In about three hundred pages he gives an excellent account of the theory of the method and a description of the most recent technique. Some of the reproductions of X-ray photographs obtained by various methods are amongst the most striking we have seen, and special mention may be made of the so-called Schiebold-Polyani diagrams (*Schichtliniendiagramme*). There are also good reproductions of photographs of models showing the arrangement of the atoms in various elements and compounds. The final article in this volume is an account by Dr. Herzfeld of the theory of the space-lattice of solid bodies to which Born has made such important contributions. H. S. A.

Amateur Telescope Making. Albert G. Ingalls, Editor. With Contributions by Russell W. Porter, Prof. Charles S. Hastings, Rev. William F. A. Ellison, Dr. George Ellery Hale, Dr. Elihu Thomson, Clarendon Ions, John M. Pierce, A. W. Everest. Pp. xii + 285. (New York: *Scientific American* Publishing Co., 1928.) 3.25 dollars.

THREE A.M. and still at it! The amateur telescope maker is represented in the frontispiece of this homely and amusing but thoroughly practical symposium as entirely absorbed in the parabolising of his mirror. When the present exclusive craze for 'wireless' has moderated, those in search of a new hobby would do well to buy this book and read it.

Ellison's "Amateur's Telescope" has long been known as almost the only practical book in English on astronomical mirror making and testing; it is valued alike by amateurs and professional opticians and has been largely reprinted in the volume now under review. In addition, there are articles and illustrations by American astronomers, opticians, and amateurs, including Prof. Charles S. Hastings of Yale and Dr. Hale of Mount Wilson; Dr. Elihu Thomson and Prof. G. W. Ritchey contribute to a miscellany of hints and suggestions.

The usefulness of Ellison's work will be considerably extended by the extra sections of the book,

especially Part I. by Russell W. Porter, which describes various mountings for amateurs' use and gives many practical details of glass working, including the making of optical flats and eyepieces. The book may, perhaps, give the impression that a great deal of optical work is somewhat easier than it really is. The fortunate learners are those who can have the guidance of an experienced worker in their early efforts, but the clear sketches and diagrams will make the way as smooth as it can be made for those who must venture alone. They will be left in no doubt as to the details of tests like the Foucault knife-edge test, and will be well guided with up-to-date information on figuring and abrasives. We think that even professional opticians may find this a handy book for reference on such points as silvering and the like.

Artificial Silk. By Prof. Dr. Franz Reinthaler. Enlarged and revised edition translated from the German by Prof. F. M. Rowe. Pp. xii + 276 + 45 plates. (London: Chapman and Hall, Ltd., 1928.) 21*s.* net.

PROF. ROWE'S translation of "Die Kunstseide und andere seidenglänzende Fasern" represents a thorough revision and considerable extension of the original German work by Dr. Reinthaler, and is undoubtedly one of the best books on the subject.

In addition to a full account of the manufacture and properties of the better known types of artificial silk, it gives adequate descriptions of Lilienfeld's viscose, the various ether silks, and of such products as staple fibre, tape, and cloth-like fabrics made directly from cellulose solutions. The section on microscopy, which is illustrated by about thirty-five photomicrographs and several diagrams, is particularly interesting: but the rest of the chapter on the properties of artificial silks might perhaps have brought out more effectively the special advantages and disadvantages of the various types of artificial silk in relation to the natural fibres. Again, some sections in the chapter on the examination and testing of artificial silks are less exhaustive than might be expected from the practical importance of such examinations. Thus in the section on the determination of artificial silk in mixed fabrics, only one method applicable to mixtures of wool and artificial silk is described, and none applicable to fabrics containing real silk.

Of the 260 pages of text, twenty-nine pages are given to the dyeing of artificial silks, seventeen to its uses, and nine to the economic situation of the industry. The final chapter deals very briefly with wild silks, vegetable silks, and modified cottons.

The Forestry Question in Great Britain. By Prof. E. P. Stebbing. Pp. viii + 217. (London: John Lane, The Bodley Head, Ltd., 1928.) 7*s.* 6*d.* net.

THIS book has been written with the view of placing before the general public the present position of forestry and its bearing upon future timber supplies. The book is divided into two parts: (1) the case for the public; (2) the case for the forester. The first part begins with a chapter on historical matter concerning forestry, and is followed by an examination of questions such as public opinion on the forestry question; the soft wood timber supplies and industrial requirements; timber supplies of the countryside; the financial aspect of the forestry problem; protective woods, beauty spots, and playgrounds; etc. In the second part of the book the author deals with technical problems, different types of forests and the reasons for growing them; privately and publicly owned forests; the work of the Forestry Commission, including the present census of British woodlands, and many other interesting problems.

The author has succeeded in producing a book that can be read with profit by both technical and non-technical people, for the technical part is so worded that it can be clearly followed by those who have not made a study of forestry questions. From Prof. Stebbing's position as chief of the Department of Forestry at the University of Edinburgh, he is well able to write with authority upon the subject under review.

Beneath Tropic Seas: a Record of Diving among the Coral Reefs of Haiti. By Dr. William Beebe. Pp. xiii + 234 + 39 plates. (New York and London: G. P. Putnam's Sons, Ltd., 1928.) 15*s.* net.

THE use of the diving helmet, the glass-bottomed boat, and the under-water camera, has given new zest to the study of marine life, and the Haitian Expedition of the Department of Tropical Research of the New York Zoological Society could scarcely have chosen more promising ground for testing the value of a floating laboratory. The scientific results of the expedition are promised in due course, but in the meantime the Director has published this volume as a popular exposition of the methods and possibilities of a new line of investigation. It is picturesquely, if somewhat diffusely, written, and gives a fair impression of the varied interests of nearly five months' exploration in the sea and in the jungle. For the would-be explorer a series of useful appendices describes the equipment necessary, the apparatus and methods of submarine photography, and the cost of the expedition, which, including the schooner, outfit, and staff of nine for five months, amounted only to about £3000.

Social Psychology: the Psychology of Political Domination. By Prof. Carl Murchison. (The International University Series in Psychology.) Pp. x + 210. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1929.) 16*s.* net.

PROF. MURCHISON does not intend his book to be used as a text-book, though according to him it may be so used by those who "are not forced to lead the life of formal quizmasters". He is worried by the barrenness of much of so-called social psychology and has attempted to make it more concrete. He considers in turn diverse subjects such as birth-control, community justice, the social contract theory, socialism, anarchy, democracy, and others, from their psychological aspects. His treatment, however, is too slight to be of substantial value.

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.]*

Ore-lead and Rock-lead and the Origin of certain Ore Deposits.

IN an earlier communication to NATURE (April 3, 1926, p. 482), I attempted to show that of the lead dispersed through igneous rocks, roughly one-half is of radioactive origin. The atomic weight of the lead of radioactive origin can be evaluated from the proportions of uranium and thorium in rocks, taking the rate of generation of lead by thorium as 0·38 times its rate of production by uranium. The following table (compiled mainly from determinations by Joly and his collaborators) covers a sufficiently wide and representative range of data for our purpose.

Type of Rock.	Uranium × 10^6 gm./gm. of Rock.	Thorium × 10^6 gm./gm. of Rock.	Th/U.
Peridotites . .	1·50	3·3	2·2
Plateau basalts .	2·25	5·1	2·3
Oceanic basalts .	3·45	6·6	1·6
Eclogites . .	0·99	1·8	1·8
Diorites and Andesites . .	5·1	9·0	1·8
'Intermediate' rocks . .	7·6	16·4	2·2
Granites . .	9·0	20·0	2·2

Adopting the value Th/U = 2·2, the mixture of lead isotopes freshly generated (54·4 per cent of 206 and 45·6 per cent of 208) would have an atomic weight of 206·91; and, since the ratio Th/U does not vary much, the mixture would be about the same for all common rocks. If we take 'uranium'-lead as 97 per cent 206·016 and 3 per cent 207·016, thus allowing for the packing effect and the presence of actinium-lead, its effectual atomic weight is found to be 206·046 (agreeing closely with several good determinations of lead from uraninites); and the mixture, with thorium-lead taken as 208·016, now becomes 206·94. Since uranium disintegrates more rapidly than thorium, the ratio Th/U must have been lower in the past than it is to-day. 1600 million years ago, for example, the value corresponding to 2·2 would have been about 1·9, and the lead then generated would have had an atomic weight of about 206·8. Thus the average lead produced and accumulated in rocks during the earth's geological history cannot have an atomic weight higher than 206·9.

In striking contrast with this result we find that the atomic weight of ore-lead from such ores as galena and cerussite never differs significantly from 207·2. The most reliable recent determinations are listed in the accompanying table.

The series 2-8 in the table is of special interest in proving that the atomic weight is independent of the period of mineralisation. If the Tertiary ore-lead be a mixture of original lead and generated lead in proportions giving a resultant atomic weight of 207·21, then obviously the others, and especially the Pre-Cambrian lead, should have had an appreciably higher atomic weight, since the proportion of generated lead was then very much smaller. It is therefore reasonably certain, if the data be representative, that no appreciable part of ordinary lead can have been derived from the radioactive elements during their terrestrial history. It follows from these results that from whatever part of the earth's interior ore-lead may have come, it must have lain in an environment where it was unaffected by radioactively generated lead. This conclusion provides additional evidence in favour of the well-supported hypothesis that within the earth the proportions of uranium and thorium fall off until they become negligible. It is also in accordance with Prof. V. M. Goldschmidt's hypothesis of the existence beneath the silicate shells of a zone which is characterised by its relative richness in metallic sulphides (NATURE, July 6, 1929, p. 15).

Source of Lead.	Atomic Weight.	Analysts and References.
1. Commercial Nitrate	207·22	Baxter and Grover, *J. Am. Chem. Soc.*, 1915, p. 1027
2. Cerussite, N.S.W. (Pre-Cambrian)	207·22	
3. Cerussite, Eifel (Carboniferous)	207·20	
4. Galena, Nassau (Carboniferous)	207·21	
5. Galena, Joplin, U.S.A. (Post Carboniferous)	207·22	
6. Cerussite, Idaho, U.S.A. (Tertiary)	207·21	
7. Galena, Wash., U.S.A. (Tertiary)	207·21	
8. Vanadinite and Wulfenite, Arizona, U.S.A. (Tertiary)	207·21	
9. Galena, U.S.A. .	207·18	Richards and Wadsworth, *ibid.*, 1916, p. 2613
10. Common lead .	207·187	Richards and Hall, *ibid.*, 1917, p. 537
11. Common lead .	207·184	Richards and Sameshima, *ibid.*, 1920, p. 928
12. Common lead .	207·18	Richards and Putzeys, *ibid.*, 1923, p. 2956
13. Common lead (Distillation fractions)	207·23	Hönigschmid and Steinheil, Berlin, *Ber.*, 56B, 1923, p. 1831
14. Common lead .	207·19	Piutti and Migliacci, *Gazz. chem. ital.*, 1924, p. 605
15. Common lead .	207·22	Gleditsch, Dorenfeldt and Berg., *J. Chem. Phys.*, 1925, p. 253
16. Common lead .	207·21	Richards, King, and Hall, *J. Am. Chem. Soc.*, 1926, p. 1530

Now, since the atomic weight of ore-lead is 207·2, and that of the lead generated within the rocks is 206·9, it follows that rock-lead, being on an average a mixture of these in equal parts, should have an atomic weight of about 207·05. In the course of a thorough search for atomic weight data bearing on the above argument, I have found a determination which seems to substantiate it. In 1923 Piutti and Migliacci determined the atomic weight of lead from the sublimate mineral, cotunnite (lead chloride), which originated during the 1906 eruption of Vesuvius (*Att. R. Accad. Lincei*, **32** (1), 468-472; 1923; and *Gazz. chem. ital.*, **54**, 605-610; 1924). Their results ranged from 207·025 to 207·079, and gave a mean value of 207·05.

For ordinary lead, as listed in the above table, their mean value was 207·19; and the difference has hitherto not been explained.

The lead in cotunnite was emitted as chloride with the catastrophic outbursts of gases that characterised the 1906 eruption. Before the eruption it must, therefore, have been dispersed through the magma responsible for the activities of Vesuvius. This particular lead can thus be justly claimed as a genuine sample of rock-lead, and the apparently abnormal value of its atomic weight can now be adequately accounted for, as it is exactly what the value for average rock-lead should be, 207·05.

Too much weight must not be given to the exact numerical coincidence, for the Vesuvius magma is a differentiated type, and we are still in ignorance as to the nature of the parent magma of which it is a residual. The parent magma may, or may not, have represented an average kind of rock-substance. The significant point is rather that for all rocks, and therefore for all corresponding rock-magmas, the atomic weight of the contained lead should lie between 206·9 and 207·2. By the case cited the validity of the deduction is established. It is to be hoped that additional atomic weight determinations will be made on lead from cotunnite and associated basic chlorides of lead occurring in other volcanic centres where the magma types are of a less specialised composition.

In the light of the very cogent evidence that has been presented, the inference can no longer be evaded that the lead of ore-bodies such as those in which galena commonly occurs cannot have been derived from the magmas of igneous rocks. Moreover, if this be true of lead, it is only reasonable to regard it as equally true of the associated sulphide-minerals, including those of silver, zinc, copper, and iron. Thus we are led to agree with Prof. J. W. Gregory—at least for certain deposits—that "the source of the ores appears to lie in a zone deeper than that of the ordinary igneous rocks" ("Economic Geology", London, 1928, p. 19). In this connexion it may be significant that in several outstanding provinces of lead-zinc deposits (for example, Pennines, Mississippi Valley, and western Transvaal) a most perplexing feature has been the failure to discover any exposures of igneous rocks with which the ores could be correlated. Prof. Gregory's hypothesis of the origin of certain ore-deposits—first published in 1906 (*Trans. R. Inst.*, 1906, p. 9)—is thus by no means inconsistent with geological observations, though it has generally been regarded as a heresy. It is nevertheless a remarkable tribute to the solidarity of science that it should first receive unequivocal support from a source so apparently unrelated as that of atomic weight determinations.

ARTHUR HOLMES.

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Durham, Sept. 3.

Compressibility of Crystals.

IN NATURE of Mar. 23, 1929, p. 448, N. Rashevsky calls into question the experimentally determined values for the compressibility coefficient. He points out that there is good evidence that sub-microscopic cracks depress the true tensile strength of materials to small values, and suggests that these cracks may likewise lead to compressibility coefficients much greater than the true coefficients, which in fact may be zero. In an attempt to estimate the volume of these cracks, he concludes that possibly several per cent of the volume of crystals is void. Since the total volume change over a range of 10,000 atmospheres is ordinarily only a few per cent, he reasons that "it is not impossible that practically the whole change of the volume is due to the decrease of the size of the cracks".

To workers in this field this suggestion is so severely iconoclastic that it should be very thoroughly examined, especially, as Rashevsky points out, since the compressibility coefficient is basic in the calculation of the exponents of the repulsive forces (or potentials) in crystals. It is the purpose of this communication to attempt to show the genuineness of the compressibility coefficient, under two headings: (1) Internal evidence from the inter-relationships of the generally accepted compressibility coefficients among themselves and with other physical properties; (2) possible volume of internal voids.

(1) The atomic volume curve of the elements (arranged according to atomic number) is very distinctly a periodic property, clearly not dependent for its periodicity upon crack formation. The compressibility curve parallels the atomic volume curve with remarkable fidelity (as shown first by Prof. T. W. Richards, *Carnegie Institution Publication*, No. 76, 1907, p. 66, but more completely later by the same author, *Jour. Frank. Inst.*, July 1924, p. 9), the alkali metals on each curve appearing at the summits of sharp peaks, but even more convincing, the small and scarcely perceptible peaks at zinc and cadmium, respectively, on the atomic volume curve appearing faithfully on the compressibility curve. Sections of this curve show a surprising parallelism, as that which includes the elements tin, antimony, tellurium, iodine, and cæsium (R. F. Mehl and B. J. Mair, *Jour. Amer. Chem. Soc.*, **49**, 1897; 1927). The atomic volumes of tin, antimony, and tellurium are, respectively, 16·2, 18·2, and 20·4. This increase is reflected in the compressibility coefficients, $1{\cdot}9 \times 10^{-6}$, $2{\cdot}4 \times 10^{-6}$, and $5{\cdot}0 \times 10^{-6}$. If it be admitted that the periodicity in the atomic volume be legitimate, it will be difficult to escape the conclusion that these compressibility coefficients are likewise legitimate.

If it is assumed that the entire or major portion of the volume decrease on pressure increase is caused by the presence of voids, it becomes difficult to understand the compressibility of such elements as tellurium, iodine, sodium, and cæsium (to choose only a few), which have initial compressibilities varying from $5{\cdot}0 \times 10^{-6}$ (tellurium) to $61{\cdot}0 \times 10^{-6}$ (cæsium), and would contract in volume under a pressure of 10,000 atmospheres to the extent of 4 per cent (tellurium), correcting for the pressure coefficient of compressibility, and 50-60 per cent (cæsium), allowing for the pressure coefficient which is not known. It can scarcely be held that the volume of the cracks can amount to so much as 50 per cent in cæsium, and with the admission of a valid and high compressibility coefficient for this element, it is difficult to deny smaller but none the less valid coefficients to the other elements in the face of the numerous and comprehensible inter-relationships which the compressibility coefficient exhibits with many other physical properties.

In addition, the heats of formation of the oxides and the chlorides of the metals parallel the compressibilities of these metals (T. W. Richards, *Smithsonian Report*, 1911, pp. 199-215), and the reciprocals of the absolute melting-points likewise closely parallel the compressibilities. It is not reasonable to assume that the heats of formation of compounds, or the melting-points of the pure metals, are in any way conditioned by the presence of cracks.

In general, it must be admitted that the many and varied inter-relationships between the compressibility coefficients as they are generally accepted and the various physical and chemical properties of the elements are presumptive evidence of common controlling

basic factors, and therefore testify to the validity of those coefficients.

(2) Rashevsky's approximation for the volume of the internal cracks is several per cent of the total volume. Direct experimental evidence can be quoted against this approximation, namely, the close agreement between the lattice constants calculated from density measurements and those measured directly by the diffraction of X-rays. Until the work of Bearden (*Proc. Nat. Acad. Sci.*, **15**, 6; June 1929) such a test could not be performed, since the lattice constant of calcite was calculated directly from the density and then used as a unit for the measurement of X-ray wave-length. It could then have been argued that calcite crystals (and other crystals) actually contain voids leading to erroneous measurements of X-ray wave-lengths. Bearden, however, has measured the wave-lengths of copper $K\alpha$ and $K\beta$ directly by diffraction from an optical grating. His results are shown in the accompanying table and compared with the measurements of Siegbahn based on the accepted lattice constant of calcite :

	$K\alpha$.	$K\beta$.	Probable Error.
Bearden . . .	1·5422	1·3926	±0·0002
Siegbahn . . .	1·5386	1·3893	±0·0005
Difference . .	0·0036	0·0033	±0·0007

It is true that there is an unexplained numerical discrepancy of 0·23 per cent between the two results, but it is of the wrong sign to be accounted for by the presence of internal cracks. That is, the presence of internal voids in calcite would lead to low density values and therefore to high values of the calculated lattice constant, which in turn would give erroneously high values for wave-length. A direct measurement of wave-length should then give lower wave-lengths, but the opposite is true.

It is scarcely pertinent to the present note to discuss the reasons which may be found to account for the discrepancy noted above—it is sufficient to point out that the data quoted in (2) cannot be reconciled with the existence of any internal voids whatsoever, but rather must be taken to signify exactly the opposite.

The above discussion does not, of course, question the reality of the surface cracks, for which there has been good experimental evidence supplied by Griffiths, Joffé, Kapitza, and Zwicky, and for which there are excellent theoretical grounds. No experimental evidence, however, has ever been presented in proof of internal cracks, and in fact the data given in (2) appear to preclude their existence. In addition, there are no theoretical considerations known, at least to us, requiring their existence. It seems certain, therefore, not only that solids have real compressibility coefficients, but also that the accepted values are very close indeed to the true values.

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Ice-bergs in a High Latitude.

THE occurrence of small ice-bergs in the northern part of the Greenland Sea—the strait between Greenland and Spitsbergen—and in the same situation, and also in a lower latitude off the Greenland coast of mud or alluvial matter on the surface of the drifting ice, are facts that appear worthy of attention.

Ice-bergs are not usually said to occur in the northern part of the Greenland Sea; Scoresby ("Arctic Regions", vol. 1, p. 104) comments on their rarity, while according to Nansen ("Hunting and Adventure in the Arctic", p. 37), "there are practically none in the whole Polar Sea". The log-books of the whaling vessels in my possession, however, prove that they do occur but are of small size, and only occur at intervals of years. For example, they are mentioned in a high latitude and at a distance from land in the log-books of both the *Eclipse* and *Hope* in 1876, in 1878, in 1883, and in 1887, but not in the intervening years.

Three of the entries in the *Eclipse's* log-book reads as follow: May 25, 1878, Lat. 79° 20′; Long. 4° 30′ east; "cruised about near the impenetrable ice; numbers of ice-bergs about, some of them had (evidently) been through a heavy sea having large lumps of (sea) ice washed up on top of them at least 12 feet above (sea) level". June 25, 1878, Lat. 79° 45′; Long. 6° east; "made (the ship) fast to an ice-berg and took fresh water ice on board". June 2, 1887, Lat. 79° 7′; Long. 2° 55′ east; "many ice-bergs in sight; seventeen being in sight from the mast-head (at one time) . . . (this year) they are equally numerous north as far as we have been" (Lat. 80° 10′).

The place of origin of these ice-bergs, a mystery in 1887, now seems to be the recently discovered Nicholas II. Land; at least, this is the conclusion I come to after reading Commander Transehe's account of its discovery (*Geographical Review*, vol. 15, p. 367). I was with my father in 1887, and can say that the ice-bergs we saw on June 2 in Lat. 79° are similar to those the Russians saw in 1913 aground near Nicholas II. Land. They were flat or table-topped and of very moderate size and height, and agree with Transehe's description. If this conclusion is correct, they probably drift north-east from Nicholas Land—parallel to the drift of the *Fram*—to a point north of Franz Joseph Land before they commence to drift south-west towards the Greenland Sea.

The fact that these small ice-bergs do not make their appearance in the northern part of the Greenland Sea every year may be due to the want of a sufficiently high tide to float them, and of a strong enough southerly wind to start them off on their long and circuitous voyage towards the sea.

Mud or alluvial matter is now well known to occur on the surface of the ice that drifts south through the Greenland Sea, but the actual finding of it does not appear to have been described. The following references to it in the log-books of the whalers may therefore prove of interest.

Log of *Eclipse*; Aug. 1, 1876, Lat. 68° 54′; Long. 20° west; "having now left the ice it will be proper to mention here that during our search for whales we have sailed amongst the ice from Lat. 80° 10′ Long. 5° east to Lat. 68° 40′ Long. 22° west, and throughout the whole of this distance much of the ice (estimated at a third) was covered more or less with a light greyish looking mud, much dispersed, and also (in places) with dark red mud, but not in such quantity. It (the latter) was always in solitary pieces by itself. From its (the mud's) appearance I (at first) thought it must have been thrown up by a volcano, but having taken a sample on board and washed it, I found it to contain a vast number of marine shells, (particles of) mica, and fine sand." Log-book of *Hope*; July 15, 1879, Lat. 78° 40′; Long. 1° 30′ west; "came to a large mound of earth of a brownish hue. . . . Its weight was (estimated to be) about 60 tons; brought some on board; found it consisting of sand and shells"; and on the fly-leaf of the log-book (a

meteorological one): "the mound of earth I fell in with on July 15th was on the ice. . . . There were numerous birds sitting on. There were also a few eggs."

The mud referred to in the whaling ships' log-books was on the surface of the ice under the snow and consequently not visible until the latter melted. A sample I collected in 1887 and showed to the late Sir John Murray, as stated in the *Zoologist*, p. 104, 1889, consisted mostly of minute particles of quartz, mica, etc., the whole, when collected and allowed to dry, cohering into a yellowish brown clay.

Like the tree trunks, mentioned in the log-books, found sometimes frozen into the ice, sometimes floating in the water, the mud obviously came from the Lena and other rivers emptying into the Arctic Ocean, but why it occurred on the surface of the ice was, in 1887, hard to understand. The explanation, which Prof. Gregory of Glasgow has kindly furnished me with, is, however, simple enough; the particles of quartz, etc., at one time suspended in the water, are incorporated in the ice when the sea freezes and, since three or four years may elapse before the ice enters the Greenland Sea, and in this period its upper surface melts in summer and its under surface is added to in winter, the particles of mineral matter rise and eventually form a layer on the top of the ice.

The quantity of mineral matter that gets transported in this way in the course of years, to be deposited eventually on the floor of the ocean far from its place of origin, seems to be much greater than is generally supposed.

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8 Hartley Road,
Exmouth, July 18.

The CH-Band at λ3143 and a New NH-Band at λ2530.

WITH a condensed spark discharge (10-40 thousand volts transformer with two Minos-jars of 4000 cm. capacity each) between tungsten and carbon electrodes 1 cm. apart in an atmosphere of hydrogen at about 7-10 cm. pressure as a source, a system of CH-bands is observed. The band with its intensity maximum at λ3143, originally reported by Fortrat (*C.R.*, **178**, 1272; 1924), appears with strong intensity together with the well-known bands at λ3900 and λ4300. The measurement of the wave-lengths, though not very accurate, and the analysis of the band have been carried out using the spectrogram taken with a Hilger quartz spectrograph E2. Fig. 1 gives the diagrammatical view of the band.

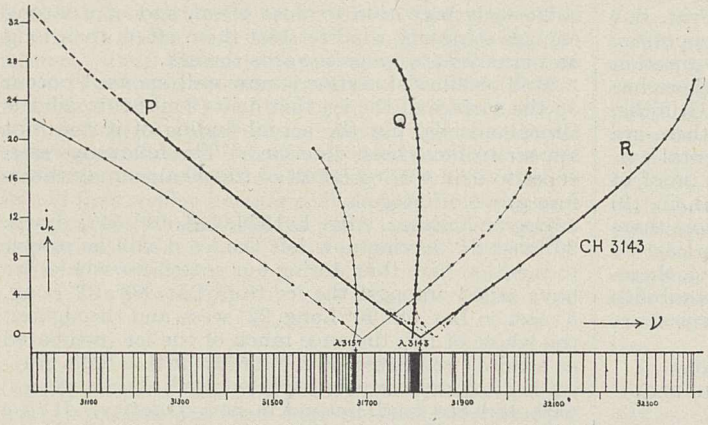

FIG. 1.—CH-band at λ3143. Strong set of branches at 3143 is the 0 – 0 band. Subsidiary band at 3157 is the 1 – 1 band.

From the general characteristics of the band, it is suggested that it belongs to a $^2\Sigma \longrightarrow {}^2\Pi$ system. In fact, it has a common final level $^2\Pi$ with the bands at λλ3900, 4300, since the combination differences $R(j_k) - P(j_k + 2)$ just coincide with those calculated by Kratzer from the data of the other two bands (*Zs. f. Phys.*, **23**, 298; 1924; cf. also Mulliken, *Phys. Rev.*, **30**, 781; 1927). The upper rotational levels as calculated from the $R(j_k) - P(j_k)$ differences are approximately given by

$$F'(j_k) = 14{\cdot}24_3 j_k(j_k + 1) - 1{\cdot}531_5 \times 10^{-3} j_k^2(j_k + 1)^2 \quad (j_k = 0, 1, 2, \ldots),$$

as it should be for a $^2\Sigma$ term. The doublet structure of the branches, which manifests itself near the origin, gives the approximate measure of the doublet spacing $^2\Pi_{\frac{3}{2}} - {}^2\Pi_{\frac{1}{2}}$. It is again coincident with the values calculated from the formula for the $^2\Pi$-terms:

$$F''(j) = 14{\cdot}2071(\sqrt{(j + \tfrac{1}{2})^2 - \sigma^2} - \rho) - 1{\cdot}4465 \times 10^{-3}(\sqrt{(j + \tfrac{1}{2})^2 - \sigma^2} - \rho),$$

where $\sigma = 1$ and $j = j_k + \frac{1}{2}$, $\rho = \frac{1}{2}$ for $^2\Pi_{\frac{3}{2}}$ term, $j = j_k - \frac{1}{2}$, $\rho = -\frac{1}{2}$ for $^2\Pi_{\frac{1}{2}}$ term (Kratzer, loc. cit., p. 306). Moreover, the σ-type doubling in the $^2\Pi$ state gives rise to a 'combination defect' in the Q-branch, which is actually observed and can well be accounted for by assuming the numerical values given by Kratzer (loc. cit., cf. Table 21). Further evidence is supplied by the study of the missing lines and relative intensities at the beginning of the branches. These are all in accordance with the theory. The nuclear distance in the $^2\Sigma$ state is $r_0' = 1{\cdot}12 \times 10^{-8}$ cm.

With the same type of discharge and a lithium electrode to avoid the contamination of the spectrum due to the tungsten lines—any other element like potassium, which has a small ionisation potential and few lines in the spectrum, answers the same purpose—in a mixture of nitrogen and hydrogen gases at about 5 cm. partial pressure, a new simple band at λ2530 has been obtained. Its intensity is feeble in comparison with the NH-band at λ3360, which appears with an abnormally great intensity together with the N_2-bands. Nevertheless, the analysis could be carried out with ease, which shows that its emitter is the NH-dipole and the corresponding transition is of $^1\Sigma \longrightarrow {}^1\Pi$ type. The nuclear separation of the molecule in its initial and final states are $r_0' = 1{\cdot}03 \times 10^{-8}$ cm. and $r_0'' = 1{\cdot}06 \times 10^{-8}$ cm. respectively. Details will be published elsewhere.

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Isomorphism and Homology.

IT is well known that the law of isomorphism discovered by Mitscherlich is now accepted with considerable limitations. Marignac, for example, showed long ago that the compounds $ZnTiF_6, 6H_2O$, $ZnCbOF_5, 6H_2O$, $ZnWO_2F_4, 6H_2O$, though homomorphous and capable of forming mixed crystals, are not identical in chemical formulæ. It is to be assumed that there are not only homologous elements but also homologous radicals. The ability to form mixed crystals, homomorphism, and identity of chemical formulæ are not necessarily co-existent. But when certain elements or radicals can be substituted totally or partially in very different salts, the analogy of these elements or radicals remains undisputable and makes legitimate the parallelism of chemical formulæ.

Dr. Pulin Behary Sarkar, working in the Inorganic

Department of this Laboratory, has been studying the relationship of chemical homology and mixed crystallisation, and starting from Langmuir's theory of 'octets', came to the conclusion that isoelectric isosteres should exhibit close relationship in chemical and physical properties.

Transport experiments showed that the so-called double fluorides of beryllium and ammonium or potassium are really complex salts having BeF_4 as a bivalent anion, though partially dissociated into Be^{++} and $4F^-$. BeF_4^{--} is isosteric and isoelectric with SO_4^{--}, having 5 atoms and 32 peripheral electrons, the covalences of beryllium and sulphur being 4 in each case. Molecular volumes of $(NH_4)_2BeF_4$, $(NH_4)_2SO_4$, K_2BeF_4, and K_2SO_4 are found to be very closely alike. They form mixed crystals in all proportions. Further, the constituent ions, namely, S^{++++++} and Be^{++}, as well as O^{--} and F^-, have identical ionic radii as determined by v. Goldschmidt.

Regarding mixed crystallisation of two chemical species, which entails equality of molecular coefficients, thermal and elastic, as the best criterion of chemical analogy, Dr. Sarkar has prepared the following double salts: K_2BeF_4, $NiSO_4$, $6H_2O$; K_2BeF_4, $ZnSO_4$, $6H_2O$; K_2BeF_4, $CoSO_4$, $6H_2O$; K_2BeF_4, $CuSO_4$, $6H_2O$, which are monoclinic and isomorphous with the well-known double sulphates of potassium and those of the magnesium family of elements studied by Locke. Curiously enough, potassium sulphate forms only the above four double salts, whereas with the double fluoride of ammonium and beryllium, Am_2BeF_4, the following isomorphous double salts have been prepared by Dr. Sarkar:

Am_2BeF_4, $NiSO_4$, $6H_2O$	Am_2BeF_4, $Fe\,SO_4$, $6H_2O$
Am_2BeF_4, $CoSO_4$, $6H_2O$	Am_2BeF_4, $MnSO_4$, $6H_2O$
Am_2BeF_4, $ZnSO_4$, $6H_2O$	Am_2BeF_4, $MgSO_4$, $6H_2O$
	Am_2BeF_4, $Cd\,SO_4$, $6H_2O$

Here also the only missing one is that of copper, as was observed by Locke with Am_2SO_4.

In the above examples, BeF_4^{--} has partially replaced SO_4^{--}. Dr. Sarkar has also succeeded in isolating a series of double salts in which SO_4 ions have been completely replaced; for example, Am_2BeF_4, $NiBeF_4$, $6H_2O$, perfectly isomorphous with the aforesaid series. Further corroborative evidence of the analogy is afforded by the preparation of the following alums: Am_2BeF_4, $Al_2(SO_4)_3$, $24H_2O$, and Am_2BeF_4, $Fe_2(SO_4)_3$, $24H_2O$.

By fusion of barium chloride with Am_2BeF_4, Dr. Sarkar has isolated crystalline $BaBeF_4$ corresponding to crystalline $BaSO_4$. The crystallographic constants of the double salts are found to be very close to those of the double sulphates studied by Tutton.

A detailed account of the investigation will appear in a forthcoming issue of the *Journal of the Indian Chemical Society*.

P. C. RÂY.

Department of Chemistry,
University College of Science
and Technology,
Calcutta, Aug. 8.

Origin of Nor'westers.

DURING spring and summer Bengal is occasionally visited by a type of severe thunderstorms locally known as the *Kal-Baisakhi*, or the 'fateful thing' of the month of *Baisakh* (April 15–May 15). These storms usually approach a station from the north-west and burst suddenly with great fury. The path of a nor'wester may vary in width from a few hundred feet to a mile, and the distance overrun seldom exceeds 50 miles. These storms are more frequent in the late afternoon, although they are known to occur also at other times of the day. A nor'wester is always associated with a thunder-shower, and the precursory signs of its approach are the same as those which herald the coming of a violent thunderstorm.

During last summer one of us (G. Chatterji) led an expedition to south Bengal to study the upper air conditions associated with nor'westers. On three occasions it was possible to collect some information from soundings by Dines and Chatterji meteorographs. A typical height-temperature graph obtained on one occasion just before the passage of a storm is reproduced in Fig. 1. It appears that the nor'wester type of thunderstorms originates through the overrunning of a warm moist southerly or south-westerly wind by

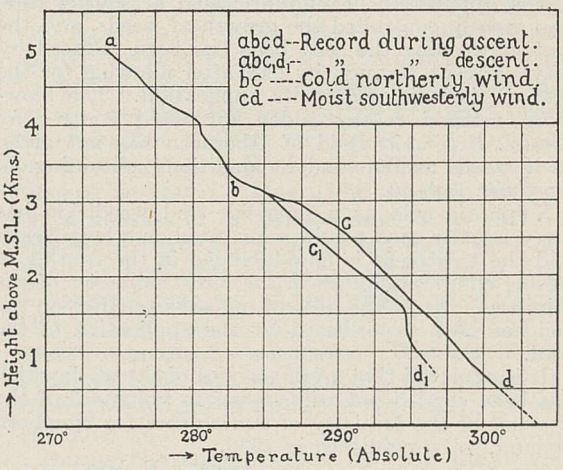

FIG. 1.—Upper air soundings over Jhikargacha, Bengal, on May 17, 1929, at 17 hr. 35 m. I.S.T., just before a nor'wester.

a westerly or north-westerly cold air with a high lapse rate. In the present case the cold air overran the moist air at 2·7 km. and extended to 3·3 km. The air in this layer had a superadiabatic lapse rate of 12° C. per km. while the air underneath was almost saturated and had a lapse rate of 5° C. per km. On all the three occasions the 'overrunning' took place in the south-eastern quadrant of a low pressure area which developed a 'wind-shift line' more or less defined.

Thus the general conditions under which nor'westers occur in Bengal appear to be exactly similar to those giving rise to 'tornadic' thunderstorms in the Mississippi Valley of the United States of America (Humphreys, "Physics of the Air", p. 344). Upper air soundings on nor'wester days show that there is a marked increase in the absolute humidity of the southerly current from the Bay of Bengal in the afternoon. This probably explains why the nor'wester type of thunderstorms is more frequent during the afternoon that at any other hour of the day.

S. C. ROY.
G. CHATTERJI.

Meteorological Office,
Ganeshkhind Road,
Poona, India, July 26.

Control of Diseases and Weeds in a Forest Nursery.

SINCE 1920 seedling diseases caused by *Corticium Solani* Bourd. and Galz. and *Botrytis* sp. have done considerable damage in the Ministry of Agriculture's forest nursery at Baronscourt, County Tyrone. The attack has involved the two species Sitka spruce (*Picea Sitchensis* Carrière) and Douglas fir (*Pseudotsuga Douglasii* Carrière).

In an attempt to eradicate the trouble, an exhaustive series of trials have been carried out with soil fungicides, including sulphuric acid, Cheshunt compound, formaldehyde, mercuric chloride, and cresylic acid. The most satisfactory results were obtained by using sulphuric acid (1 in 80) applied to the soil on the same day as the seeds were sown. Cheshunt compound did not prove to be nearly so valuable as a fungicide for this particular purpose, although when applied to growing seedlings it exerted a distinct manurial effect and stimulated growth. Formaldehyde, mercuric chloride, and cresylic acid did not give results which could be compared with those obtained by using sulphuric acid.

The application of sulphuric acid at sowing time also greatly controlled the growth of weeds, and the cost of weeding the seed beds has been reduced by fifty per cent through its use, after allowing for the cost of the acid and of its application. The blow-lamp method recommended for weed control by Messrs. Benjamin Reid of Aberdeen has not given such good results under conditions obtaining in Northern Ireland.

Sulphuric acid as a fungicide and weedicide has given equally good results when used on a large scale, and the treatment is now included in the routine of raising conifer seedlings in the forest nurseries of the Ministry. Up to the present, no adverse effect on the soil has been experienced by the application of the acid.

It is expected that a full account of the work which has been carried out will appear in volume 3 of the *Journal* of the Ministry of Agriculture for Northern Ireland, to be published in 1930.

ARTHUR E. MUSKETT.

Department of Agricultural Botany,
Queen's University,
Belfast.

The Frenkel Adsorption Isotherm.

DURING an investigation into the temperature coefficient of the adsorption maximum of gases on a solid surface, we have had occasion to examine the Frenkel adsorption isotherm. This is written (*Zeit. f. Phys.*, **26**, 133; 1924, equation 9a):

$$\frac{S}{n} = \sigma_0\left(1 + \frac{\sqrt{2\pi mkT}}{p\sigma_0\tau_0}\right)e^{-u_0/kT}$$

Frenkel deduces from this equation that at sufficiently low values of T the number of adsorbed molecules, n, approximates to a maximum value S/σ_0. It is difficult to see how this result is obtained. When p is very large this isotherm gives at the saturation maximum a value of n which approximates to $\frac{S}{\sigma_0} \cdot e^{u_0/kT}$, and it is therefore at high temperatures and not low that n approaches S/σ_0. Moreover, the existence of a marked temperature coefficient in the value of the adsorption maximum is very surprising, for the Langmuir isotherm which was developed from almost identical assumptions and using the same method has not this temperature coefficient.

A closer examination of the equation has explained the discrepancy, for it appears that Frenkel has made a slight algebraic error in deducing the final equation. The corrected isotherm is

$$\frac{S}{n} = \sigma_0\left(1 + \frac{\sqrt{2\pi mkT}}{p\sigma_0\tau_0} \cdot e^{-u_0/kT}\right),$$

which gives the saturation maximum S/σ_0 which is independent of T.

F. J. WILKINS.
A. F. H. WARD.

Laboratory of Physical Chemistry,
Cambridge, Aug. 14.

Attempts to induce Rainfall.

THE Colony of Hong-Kong has suffered from an unprecedented deficiency in rainfall during the twelve months ending June 30, 1929, with consequent distress to the population, owing to water shortage.

Amongst the many suggestions received from the public by the local Government was the proposition that powdered kaolin, sprinkled from aeroplanes above suitable clouds, would induce precipitation; the method was stated to have been employed with success in other countries. After discussion with other government officials, I made the following recommendation:—

"I consider that the experiment might reasonably be attempted once. I have little doubt of its failure, but this avenue of relief may then be considered sufficiently explored and be definitely closed thereafter."

My personal opinion is plainly expressed in the foregoing; had the Government refused to countenance the experiment, however, there would have remained a feeling in the public mind that one possible solution of the water problem had not been tried. The experiment was made by the unit of the R.A.F. stationed here, and no precipitation occurred.

The reports in the local press are now being commented upon by journals outside the Colony, usually with the implication that this Observatory was responsible for the inception and conduct of the experiments. This was not the case; the experiments were authorised by the Government to discount any subsequent criticism. No belief in a materially successful result was held by the administration or its advisers, including my colleagues and myself.

C. W. JEFFRIES
(Acting Director).

Royal Observatory,
Hong-Kong, July 31.

Dew: Does it Rise or Fall?

I THINK it may be said to do both. There is no doubt, as Mr. John Aitken proved many years ago, that *real* dew rises as vapour from the ground and condenses on cold surfaces near the ground. This may be observed on plantain or dandelion leaves growing, for example, on a hard gravel path; the hard material loses its heat slowly during the night and, though there is no visible condensation, moisture continues to rise. The leaves will radiate their heat after sundown from the upper surface and moisture will deposit on the under surface only. There are, of course, other ways of showing the same effect.

Another form of dew, which may be termed *false* dew, is caused by cold air, formed during radiation, flowing from a higher to a lower level. The cold air tends to cool the objects with which it is in contact and the water vapour present in the warmer air is thereby condensed. Mist over water and marshy ground is formed in this way and this dew may therefore be said to fall. Some years ago I was able to show that at the lake level at Coniston the temperature of the air in the early morning before sunrise was several degrees lower than at the top of the Coniston Old Man (2633 ft.), and whereas the grass was dripping with moisture at the foot of the mountain, that on the top was as dry as on a warm summer's day. The cold air had descended and been replaced by the warmer air from below.

J. B. COHEN.

Coniston.

Progress of the Discovery Investigations.[1]

By Dr. STANLEY KEMP.

SINCE the R.R.S. *Discovery* returned to England at the end of 1927, the oceanographic and whaling investigations which the Discovery Committee is conducting in the South Atlantic have been continued with the R.S.S. *William Scoresby* and at the Marine Biological Station in South Georgia.

R.S.S. *William Scoresby*.

The *William Scoresby* sailed from Cowes in the last week of 1927 with Mr. D. Dilwyn John in charge of the scientific work. The commencement of the voyage was marked by a tragedy, for two days after leaving port, in a heavy gale in the Bay of Biscay, leading seaman Sydney Cook was washed overboard and lost. During the previous commission he had proved himself a cheerful and willing member of the small ship's company, and his practical experience of trawling had been a valuable asset. Shortly before reaching the Falkland Islands the vessel met a number of fin whales and experiments were made in whale-marking. Eight hits were recorded, and it is believed that at least five whales were marked.

On Feb. 7 the *Scoresby* left for South Georgia, taking on the passage a line of seven stations, mostly in deep water, at which observations were made on plankton and hydrology. As in the previous season, icebergs were unusually numerous, and one of the stations was taken under the lee of a berg estimated to have a length of 50 miles. At South Georgia the vessel was engaged until Mar. 13 in repeating the survey of the planktonic and hydrological conditions on the whaling grounds. This survey was hindered by fog and the presence of ice, but 48 stations were taken, 21 consisting mainly of plankton observations and 27 with full hydrological observations in addition. With the view of testing the uniformity of the plankton distribution in the area, series of continuous hauls with plankton nets were made during the course of the survey. One series of hauls with surface nets was made, and two with oblique nets worked from 100 metres to the surface. The rather difficult technique involved in the latter operations owes much to the ingenuity of Mr. F. E. C. Davies, now acting chief officer of the vessel.

At the conclusion of the survey the *Scoresby* unfortunately touched a rock in the approaches to Stromness Harbour. This caused damage to the stern frame, and delayed resumption of work until April 14, when the whaling season was concluding. The whaling factories reported that pack-ice was closing in on the South Shetlands, and some of them had already left on the return voyage to Europe.

In these conditions it was not possible to complete the full programme. The *Scoresby* sailed from South Georgia on a south-westerly course and, after six deep-water stations had been taken, met pack-ice about 40 miles north of Clarence Island, the seventh station being worked in an open lane in the ice. The sea on this occasion was ominously calm and it became apparent that the vessel was sheltered by an extension of the pack lying to the north. During the night a south-west gale arose and the vessel succeeded with some difficulty in getting clear, with her decks and superstructure heavily coated with ice. So far as could be ascertained, the pack-ice formed an impenetrable barrier to further progress in a southerly direction, and a course was therefore set for the Falkland Islands. Seven further stations were taken, including three on the Burdwood Bank, and Port Stanley was reached on May 1. One night, when in the pack-ice, a number of fin whales came close up to the ship, apparently attracted by the lights on board; marking guns were brought into operation, and it is believed that six of the whales were marked. This passage was the most difficult that has been made during the investigations. Weather of exceptional severity was encountered throughout, and for eight days out of a total of seventeen the vessel was hove to.

During the winter season of 1928 the *William Scoresby* continued the trawling survey which had been begun in 1926 of the plateau round the Falkland Islands. About 38 trawling stations were taken over an area some 400 miles in length by 300 miles in breadth. During this work particular attention was paid to the edge of the continental slope, where it was thought that hake (the fish of greatest economic importance in the region) might occur plentifully. The results of this trawling survey cannot yet be definitely assessed. That they are not unpromising may be judged from the fact that in several areas hake were found in marketable quantities, though the season in which the operations have hitherto been conducted may be expected (on analogy with northern fisheries) to be the least productive.

In order to obtain some knowledge of the winter conditions on the whaling grounds, the *Scoresby* left Port Stanley for South Georgia on Aug. 19, repeating *en route* the series of stations taken earlier in the year. After arrival, though much interrupted by gales, fog, and snow, four lines of stations were completed and a further series of continuous surface nets was hauled.

Since the Discovery investigations began, the methods of operation of the whaling factories in the Dependencies have undergone a marked change. Four years ago these factory ships lay at anchor at Deception Island, or in other harbours in the South Shetlands, while their whale catchers worked in the neighbouring area. Recently, however, the factory ships have been taken along the edge of the pack, where the only shelter is that which the ice may afford; and since whales have been found in abundance, this more dangerous method of

[1] For previous accounts of the investigations see NATURE, Oct. 30, 1926, and May 19, 1928.

operation has become general. The area worked in this way extends across the mouth of the Weddell Sea from Elephant Island and the South Orkneys so far east as the South Sandwich Islands.

In September 1928 the *Scoresby* left South Georgia to observe conditions along the ice edge, but the first attempt, when pack-ice was found 120 miles east of the island, was rendered abortive

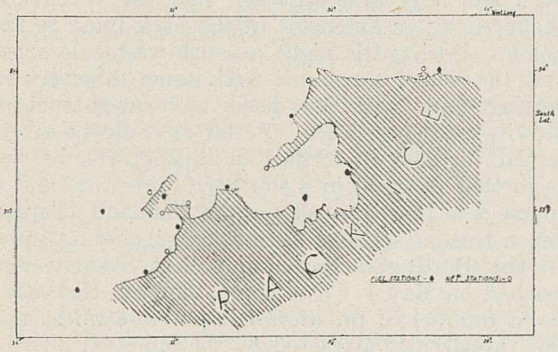

FIG. 1.—Chart illustrating the work carried out by the R.S.S. *William Scoresby* along the edge of the pack-ice to the east of South Georgia in September and October 1928.

by the onset of heavy weather. In the early days of October a line of stations was taken south-eastwards from Cooper Island, and continuing on an easterly course the pack was found in Lat. 55° 27′ S., Long. 32° 21′ W. With a westerly breeze the edge of the pack was often very sharply defined and frequently it was possible to make observations at its actual margin. The ice edge was followed in an easterly direction for several days, and as shown in Fig. 1, 13 stations were taken along a length of 300 miles. Mr. M. C. Lester, chief officer of the *Scoresby*, made some useful observations on ice conditions. The plankton was found to be characterised by a number of forms which are not found on the South Georgia grounds, among them *Euphausia crystallorophias*. This species was found in considerable abundance and may prove to be the chief food of whales frequenting the ice edge.

Returning to South Georgia the *Scoresby* was docked, and with minor repairs and boiler cleaning was not ready for sea until the end of November. She then made a passage to Port Stanley, again taking a line of stations, and on returning to South Georgia she began an extended survey of the whaling grounds. This survey, which is illustrated in Fig. 2, is the most thorough which has yet been made. The lines of stations extend seawards far beyond those previously taken. Of the total number of 53 stations, 44 include full hydrological observations in addition to the plankton work. In spite of very severe weather during the first half of the period, the entire survey was completed in one month (Dec. 16–Jan. 15), during which the two members of the scientific staff (Messrs. D. D. John and J. W. S. Marr) worked almost unceasingly. Great credit is due to them and also to Capt. R. L. V. Shannon and his crew, for a very remarkable performance. At the conclusion of the survey a series of continuous oblique nets was hauled over a distance of 30 miles.

The cruise to the South Shetlands, which (as already explained) was frustrated by pack-ice in the previous season, began on Feb. 5, and the entire programme as shown in Fig. 3 was put through without the necessity of returning to South Georgia for fuel. Between South Georgia and the South Shetlands eight stations were taken, and in the Bransfield Strait, where peculiar hydrological conditions exist, three lines of stations were made. The return passage to the Falkland Islands was made via Drake Strait and Cape Horn. Here the weather lived up to its evil reputation, and the seven stations on this line were accomplished with some difficulty in heavy swells. Three further stations were taken between the Straits of Lemaire and the Falkland Islands, and seven plankton stations on the return to South Georgia. The season's work concluded with two lines of stations on the south-west side of the island.

In this brief synopsis of the work done by the *William Scoresby* during some sixteen months, it has not been possible to make any statement regarding the results obtained. The small scientific staff, for most of the time only two in number, was very fully occupied in the collection of data and material and was without time even for a

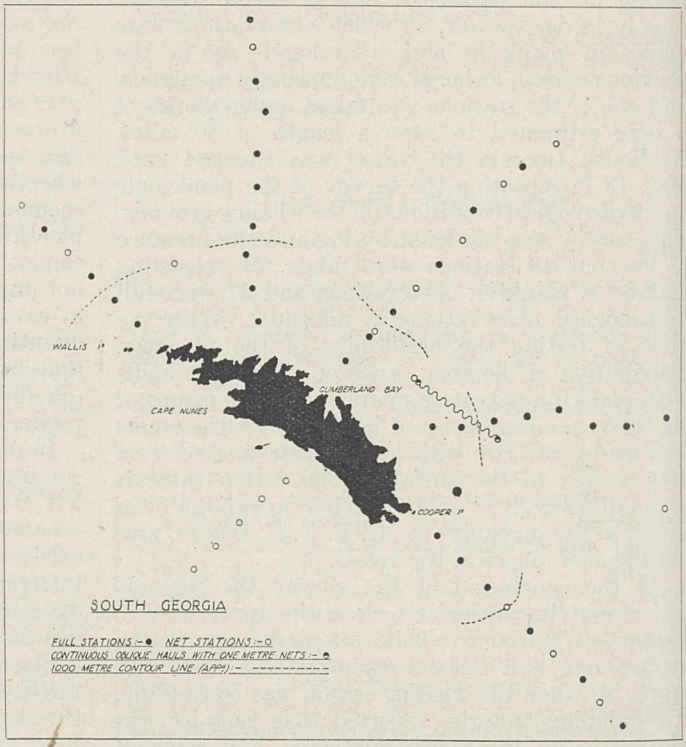

FIG. 2.—Chart illustrating the work carried out by the R.S.S. *William Scoresby* off South Georgia during December 1928 and January 1929.

preliminary inspection of what had been obtained. There are indications that results of great interest will follow, but at the moment all that can be said is that, thanks to the enthusiasm shown by the personnel, the work of maintaining continuity of observations during the past two seasons has been most successfully performed. On three different occasions surveys of the South Georgia whaling grounds have been carried out; connected lines of stations have been taken covering a wide area, and special observations have been made in Bransfield Strait. The trawling survey in the Falkland area has been continued and valuable work done on the edge of the pack-ice.

WHALE-MARKING.

The *William Scoresby* has been so fully occupied with observations on plankton and hydrology that, as was foreseen, she was not able to make any serious experiments in whale-marking. During the past season, however, the Discovery Committee was able to arrange with one of the whaling companies at South Georgia for the occasional use for this purpose of their spare whale catcher. Three cruises, each accompanied by one of the scientific staff, have been made in this vessel. On the first occasion a visit was paid to the ice edge east and south of South Georgia, where many whales had been sighted by the *Scoresby*, but owing to the very bad weather which was encountered only two whales were marked. The remaining two cruises, each completed in three days, were made on the South Georgia grounds and proved far more successful.

On the first occasion 72 certain hits and 13 doubtful were recorded, while on the second the figures are 25 certain and 2 doubtful. It is thought that at least 13 whales on the first occasion and 3 on the second were marked twice. The whale-marking operations were in charge of Mr. J. W. S. Marr and Mr. G. Rayner, Capt. Evensen, who was in command of the vessel, doing his utmost to ensure success.

Since the investigations began, more than a hundred whales have now been marked, most of them during the present year. So far, no marks have been returned and the possibility that some may have been overlooked during the process of flensing is disquieting. Recent experiments have resulted in the production of an improved mark, having an aluminium shaft which will not warp under sea-going conditions, a stream-line covering to the head, giving flatter trajectory and increased range, and with a tag of brightly coloured material attached to facilitate recognition.

WHALING FACTORIES.

During the past two seasons opportunities have arisen for undertaking some scientific work on whaling vessels. In 1928, Mr. J. E. Hamilton accompanied the whaling factory *Anglo-Norse* on an expedition to the South Sandwich Islands, and in the following season Dr. E. H. Marshall visited the Ross Sea in the *C.A. Larsen*. On each of these voyages data were obtained on all whales captured, and as a result of facilities kindly given by the managers, serial observations on the hydrology and plankton were also made. The work accomplished will be of value in comparison with the more detailed investigations carried out on the research ships and at the biological station.

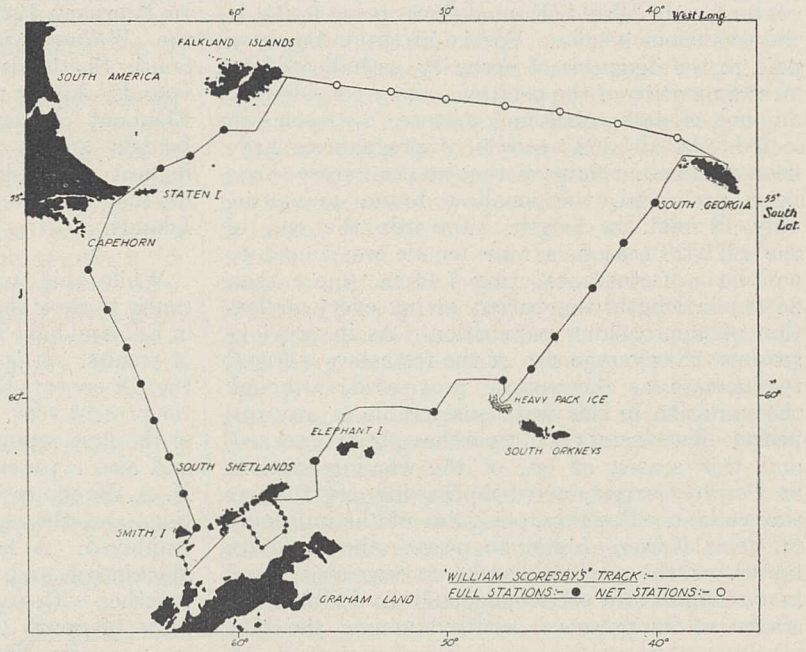

FIG. 3.—Chart illustrating series of observations between the Falkland Islands and their Dependencies made by the R.S.S. *William Scoresby* during February 1929.

THE MARINE BIOLOGICAL STATION, SOUTH GEORGIA.

The Marine Biological Station was reopened at the beginning of February 1928, with Mr. F. C. Fraser in charge, and from then until it was closed at the end of April 1929, 836 whales have been examined at the neighbouring whaling station. The staff also examined 29 whales at Deception Island, which was touched on the voyage to South Georgia, making a total of 2549 whales examined since the observations were commenced in 1925.

Most of the routine work of previous seasons has been continued. This includes observations on colour, external and internal parasites, stomach contents, condition of blubber, of external and internal genitalia and of mammary glands. All mature females have been examined for fœtuses.

In previous seasons full series of measurements have been taken of every whale examined, but sufficient data of this kind had already been obtained for blue and fin whales, and in consequence full measurements were only taken of other species.

Altogether, whales of five different species have been examined. Blue and fin whales have been predominant, sei whales have occurred towards the end of both seasons, sperms have been taken more infrequently, and three humpbacks were examined during the few days allowed for their capture in December 1928.

Considerable variability was found to exist in the different species in the proportions of males to females. In blue and fin whales, males and females occurred in approximately equal numbers, by far the greater number of sei whales examined were female, and all the sperm whales were male. The stomachs of all whales were examined for food content, only 'krill' (Euphausians) being found in the whalebone whales. Special attention has been paid to the diagnosis of maturity, as indicated by an examination of the genitalia, and a considerable amount of data concerning fœtuses has been collected. In all, 124 records of pregnancies have been obtained. Many of the smaller fœtuses have been preserved, the smallest found measuring only 18 mm. in length. Towards the end of the 1927–28 season, a blue female was found to contain a fœtus measuring 7·46 m. (more than 24 ft.) in length, the parent giving every indication of approaching parturition. As in previous seasons, the average size of the fœtuses was found to increase as the season progressed, although the variation in size was considerable at any one period. Two instances of twins have been observed, and this season at one of the whaling stations at South Georgia, a whale having six fœtuses was caught. Roughly, one-third of the immature fin females were found to possess the structure known as the vaginal band. It was also found in one immature sei female, and a doubtful instance of its presence occurred among the blue whales.

The mammary glands of all female whales have been examined and the presence of milk recorded. The stomachs of young whales have been examined for evidence of milk feeding. Although it is exceptional, two fin whales and one sei whale were found to be pregnant and lactating at the same time.

Observations on the colonies of elephant seal which inhabit South Georgia were made from time to time by Mr. G. Rayner, and Mr. G. E. R. Deacon, hydrologist, was fully occupied in the analysis of water samples obtained by the *William Scoresby*.

Coastal Survey.

During the previous commission the survey officer, whose services had been lent to the Committee by the Admiralty, was chief officer of the R.R.S. *Discovery*. Facilities for survey were given whenever possible, and a considerable amount of useful work was done, but the Committee felt that it would be an advantage in future operations to detach a survey party as a separate unit, thus allowing the officer-in-charge to devote his whole time to this work. In accordance with this plan, Lieut.-Comdr. J. M. Chaplin left England by a whaling transport vessel in September 1928. He took with him an assistant, a motor mechanic, and three men, together with a specially designed motor launch. The party arrived in South Georgia in October, and work began at the end of the month.

The season was a bad one for survey operations; much fog prevailed, and sights could only be obtained on rare occasions. In Stromness Bay, Husvik, Leith, and Stromness harbours were surveyed in detail, with some soundings in the approaches, and surveys were also carried out at Maiviken and Jason Harbour in East Cumberland Bay and at Godthull farther to the south-east. In February 1929 the survey officer accompanied the *William Scoresby* on her passage to the South Shetlands, Cape Horn, and the Falkland Islands, during which observations were made at Elephant Island and near Smith and Low Islands and a round of angles taken from the highest point of Deception Island. Observations for magnetic variation were made in the Falkland Islands.

While this work has been in progress in the south, those of the scientific staff who have remained in England have been occupied with the preparation of results. It is expected that the first volume of the Discovery Reports will be completed during the present year. A station list covering the period of the first commission has already been published and also a paper by S. Kemp, A. C. Hardy, and N. A. Mackintosh on the objects of the investigations and the equipment and methods which are employed. A lengthy whaling report by N. A. Mackintosh and J. F. G. Wheeler is in the press, together with papers on elephant seal and on the birds of South Georgia by L. H. Matthews, and on parasitic Nematoda and Acanthocephala by H. A. Baylis. Work on certain of the hydrological and plankton results is well advanced. The Admiralty has recently published charts embodying surveys carried out by Lieut.-Comdr. J. M. Chaplin, and these charts will also be issued with the Discovery Reports.

The *Discovery* has been chartered to the Commonwealth Government for an Antarctic expedition under Sir Douglas Mawson, with Captain J. K. Davis in command of the vessel. Mr. J. W. S. Marr, of the Discovery Committee's scientific staff, has been seconded to accompany the Australian expedition, on which he will take charge of the plankton investigations. For the continuance of the Committee's work in the Dependencies of the Falkland Islands, a new vessel, to be named the *Discovery II.*, is now under construction at Port Glasgow, and it is expected that she will be ready to sail for the south before the end of the present year.

National Surveys.[1]

By Brigadier E. M. JACK, C.B., C.M.G., D.S.O.

EVERY civilised country—I think without exception—has a national survey; that is, a survey department, or in some cases more than one department, controlled by the government. But when we come to inquire into their activities, we find considerable differences in organisation and methods and in the actual duties allotted to these departments, and it becomes a matter of interest to inquire what are, or should be, the characteristics and functions of a national survey.

One function should be the production of a map. Here we are faced with the fact that every country must decide for itself what maps it requires. Because Great Britain publishes maps on seven different scales it does not follow that South Africa need do the same. The maps required by a country depend on local conditions and circumstances. It is clearly impossible to lay down any hard and fast rules, but we may perhaps arrive at some general principles.

I have spoken of there being an infinite variety of maps, but they may be divided into different kinds and classes, and for our purpose it will be convenient to consider maps under two main headings, namely, cadastral and topographical. My own view is that it is the proper function of a national survey to make adequate provision for maps of these two kinds, cadastral and topographical, because I consider them of such great importance to any community and any country.

The functions of a national survey, and the duties for which I think it should be responsible, are as follow:

1. The national survey should be the sole survey authority in the country.

2. It should be under one control in all its operations, from the triangulation to the publication and sale of the map, and its revision.

3. It should be responsible for an accurate network of levels throughout the country.

4. It should produce, or control the production of, all cadastral maps.

5. It should produce, or control the production of, a good topographical map of the whole country.

6. Maps used for land registry or similar government purposes should be the national survey maps, or directly based on them.

7. All maps produced by or under the control of the national survey should be reproduced and should be readily available to the public.

8. Adequate provision should be made for the revision of all maps.

Let us now consider some of the national surveys of the world, and see to what extent they comply with, or differ from, the standard which I have laid down.

Taking the surveys of Europe first, we find a strong likeness among them. They all, or nearly all, have certain characteristics in common. These are, first, that a military department is responsible for all topographical mapping in the country; second, that such cadastral maps as exist are produced by an independent department; third, that it is very rare to find cadastral maps published. The view taken generally in Europe is that good topographical maps are a prime necessity for military purposes, hence the military character of their topographical surveys; that cadastral maps have no military value, and are chiefly required for revenue purposes; and that such cadastral maps are documents mainly for government use, or for occasional reference by the public, so that reproduction and publication are unnecessary. As a result of these views we find that, generally speaking, European countries have good topographical maps.

The Survey of Egypt has a wide reputation for excellence and efficiency, and it is fair to note that its organisation and development are due almost entirely to British control and supervision. In Egypt we find one survey department, responsible for all survey operations, including levelling.

It may fairly be said that Canada is showing a fine example in carrying out systematic surveys of her territories, surveys geodetic, topographical, and cadastral. At the same time I do not think that the organisation of surveys in Canada or in the United States is one to be copied. It is fairly obvious that there has been in the past a great deal of independent and un-co-ordinated effort in both countries and that the present situation, while no doubt working well practically, is a compromise; and the suggestive and advisory functions of a board can never, in my opinion, take the place of the personal control of a director.

The Survey of India has deservedly a world-wide reputation. It is a highly organised and admirable survey, which in its geodetic and other scientific work can bear comparison with any other in the world. On the mapping side its activities are, however, confined solely to topographical work. The Survey of India produces maps on the scales of 1-inch, $\frac{1}{2}$-inch, and $\frac{1}{4}$-inch to the mile, as well as various smaller scales. Revision of these topographical maps is contemplated, but exists more in theory than in practice. The Survey prints and publishes its own maps.

Cadastral work in India is done on a provincial basis. A native official called the *patwari* of each village is responsible for keeping up-to-date a map of his village, with its property boundaries. In some provinces the technical part of these surveys is done under an officer lent by the Survey of India.

Ceylon has a first-rate survey, which is responsible for all operations; and the same applies to the Federated Malay States Survey. Similarly, most of the African Colonies and Protectorates have a single survey authority, responsible for all survey work in the country. Examples are the Gold Coast, Nigeria, and Uganda, in which, although the survey is in an early stage and much territory remains to be done, the organisation and the

[1] From the presidential address to Section E (Geography) of the British Association, delivered at Cape Town on July 23.

programme of work are complete and comprehensive, and often include schools of training for natives, and full equipment for reproducing and printing their own maps. On the other hand, we get Nyasaland, with a 'Lands Officer' and a negligible staff; and Northern Rhodesia, where a very small staff is wholly occupied with cadastral work, and has neither the means nor the opportunity to undertake much-needed trigonometrical and topographical work.

In both Australia and New Zealand a great deal of cadastral work is done, in the form of surveys of property and lands, frequently isolated; but in neither country is there, so far as my information goes, any system of cadastral survey organised on the lines we have been considering.

New Zealand has a few topographical maps, mainly of manœuvre areas, produced under the military department. In Australia topographical maps are, according to my information, almost completely lacking. New South Wales has a triangulation of the highest class, and a certain amount exists in other States. Proposals have been made for carrying out a geodetic survey of the whole of the States under Federal arrangements; but these proposals contemplated only the establishment of first and second order triangulation, and so far as I am aware did not even entertain the idea of carrying the work through to the stage of mapping.

In any statement of the form that an ideal national survey should take, I would lay great stress on the desirability of unity of control of all forms of survey. There should be only one survey authority in a country, and there should be a single control of all survey operations from start to finish. Perhaps the chief point that strikes one in analysing the organisation of national surveys is the lack of such unity. If we except the Ordnance Survey and the Survey of Egypt, and certain British colonial surveys, such unity of control is conspicuous by its absence; and one of the most characteristic features of foreign surveys is the almost complete divorce of cadastral from topographical work. They seem to be commonly regarded as things apart.

The idea of a single department responsible for all forms of survey appears to be a British idea, as it is only in countries of British nationality or controlled by British that it is found. In fact it might almost seem that in stating what I believe to be the sound and ideal form of organisation for a national survey I was merely quoting the practice of the Ordnance Survey. But that is not so. I do not argue that the organisation that I advocate is right merely because it is that of the Ordnance Survey, but because it seems to me absolutely sound and defensible arguing from first principles. The British people have an extraordinary faculty for getting practical things done, and in the end often done well; but logical and orderly thinking out and arrangement is the last quality I would claim for them as a race. Yet it does seem to me that in survey matters the British have developed eminently logical and sound ideas and have put them most beneficially into practice.

All surveyors will agree that the idea that there is any essential difference between a cadastral and a topographical map is absurd; the difference is merely one of degree and not of kind. It seems, therefore, logical to argue that both should be produced and maintained by the surveyor. Indeed, one may put it more strongly, for it is obviously wasteful to send one party into the field to produce one kind of map, and another to produce another kind, when one good map would serve as a basis for all kinds. In Europe the so-called cadastral maps are regarded much less as maps than as diagrams and documents necessary for the purpose of supervising revenue. They have become to a large extent the documents of a financial department. The question obviously arises whether the countries in question have suffered from this policy. If the argument that all survey should be under one direction is sound, one should be able to show that some disadvantage has resulted where this rule has not been followed. Can this be shown? Let us take France as a typical example.

France has a cadastral survey, on a large scale—usually 1 : 2500—made on the average about a hundred years ago. So far as one can judge—and we had opportunities for doing so during the War—this survey, though not based on any triangulation, was a reasonably accurate one. It has been left practically untouched since. The manuscript plans that one may see on application in the *mairie* of any commune show the country as it was in the time of Napoleon.

This survey must have cost a lot of money to carry out, and the map when produced must have been of great value to the country. Owing to lack of revision, the value of that map to the country has steadily deteriorated until now, when it must be widely negligible. I cannot believe that if this map had been in charge of a surveyor it would have been allowed to deteriorate in this way. I cannot believe that he would not have maintained it and made as accurate a map as possible. It appears to me, therefore, that France has definitely suffered from allowing this once valuable map to remain in charge of a purely fiscal department.

Take the question of publication. To survey and map any country is an expensive business; and it is particularly expensive to carry out a cadastral survey, presuming that it is a reasonably accurate survey, on account of its large scale and the great amount of detail that has to be mapped. Now the cost of reproducing and printing such maps is almost infinitesimal compared with the cost of surveying them; and it seems to me a 'penny wise and pound foolish' policy to refrain from the small extra expense that would be entailed by publication. The maps embody a large amount of information of value to the public, and obtained at public expense. It seems only reasonable, therefore, that this information should be made available to the public.

Human activities take very similar forms all the world over, though there may be superficial differences. Since the world began men have bought and sold houses, estates, lands; and a usual accompaniment of such sales is a map or plan. In

England, where accurate 25-inch plans exist for all cultivated and inhabited country, it is easy to obtain such a plan. In France, where the once good plans no longer have any value, they must be made afresh. Here again I think we may say that France has suffered through not carrying through her survey policy to its logical conclusion.

Another point that may be mentioned is the question of military value. European countries assumed prior to the War that cadastral maps were of no military value. As the War went on, the demand grew for maps of larger and larger scale. England was no wiser in this respect; but she was much wiser in her survey policy. Had the war occurred in England, it would have been an easy matter to supply maps of any scale required. In France how often must the armies have wished that good, accurate large-scale maps were available! As it was, we had to make those maps ourselves. We used the hundred-year-old French cadastrals, and were very glad to have them; but how enormously their value would have been enhanced had they been modern, up-to-date maps!

The conclusion seems justified that France has suffered definite disadvantages owing to her policy of letting her cadastral maps become mere documents of a financial department, and of not carrying out her survey to its complete and logical end; and the same conclusion will apply to other countries in a similar situation.

In the United States and in Canada division of responsibility of another kind used to exist. The disadvantages of such a state of things and the need for unity of control was felt, and has been met by the establishment of Survey Boards. I believe that the existing system works well and without friction, but I believe also that this is due mainly to the common sense and goodwill of the men working it, rather than to any advantages in the system.

What is the survey situation in South Africa at present? In January 1921 a Survey Commission was appointed, and in July of the same year it issued a report. This was not by any means the first report on survey questions in this country that had been made; nor was this Commission the only one that has investigated the subject; but as it is the latest, and the only one on the recommendations of which action has been taken, we may confine our attention to it. The report of this Commission is a most admirable document; and if I quote from it, my excuse must be that Government documents are seldom read except by the few who are professionally and immediately interested.

The Commission directed attention to the great waste that resulted to the country in the absence of a scientific system of carrying out cadastral surveys; it pointed out the need for greater co-ordination and unity of control in survey matters; and it dwelt very strongly and forcibly on the great need for a good topographical map of the country. The Commission made a large number of recommendations, all in the direction of securing greater unity and more reliability and scientific precision in the surveys of the country, and of making the survey more complete and comprehensive. As a consequence of this report, in 1927 a Survey Act was passed, which gave effect to most of the recommendations of the Commission, though not to all.

The situation with regard to cadastral surveys in South Africa is difficult. A vast amount of surveys of farms and properties has been done, and exists stored in various archives. It varies largely in quality, but includes much most valuable material. But it is most difficult of access, and it has long been felt by the thinking surveyors of South Africa that more use should be made of it. The subject has been ably dealt with in an article in the *Survey Journal* for March 1924 by Mr. Whittingdale, who argues that it should be collected, co-ordinated, and plotted in the form of a regular series of cadastral plans. Whether such a work would be practicable I am not competent to say, though it is interesting to note in the same article that experimental cadastral plans, presumably made in the suggested way, have already been constructed in the office of the Surveyor-General, Cape Town. But of its desirability I have no doubt whatever. It is, to my mind, a cardinal principle that survey work that is done should be published and made available; otherwise it is largely wasted; and the preparation of a series of uniform cadastral plans of the dominion should, I think, take a high place in the Survey programme. It should not be forgotten, of course, that certain compilations of the existing farm surveys have been made in the Transvaal, Orange Free State, and Natal, but these do not quite meet the want.

The Survey Commission did not touch on the question of a regular cadastral map, but it devoted a substantial part of its report to the subject of topographical survey. South Africa is at present singularly deficient in good topographical maps, and there is, I think, little doubt that they are a crying need. The need for such a survey has been consistently advocated for many years past; and it is difficult to add anything of value to the arguments which have already so often been put forward. My excuse for speaking at all on the subject is that public apathy in the matter is so great that it is only by constant reiteration that one may entertain a faint hope that at some time a little interest may be aroused.

The Survey Commission stated that in South Africa a topographical survey is particularly necessary from the geographical circumstances of the country. It pointed out that, in the absence of waterways, roads and railways must be laid down before a country can begin to progress; and further, that irrigation and conservation of water will play a great part in the development of the land. It then stated that a necessary preliminary to undertaking any schemes of the nature mentioned was a knowledge of the topography, and that a good topographical map would save enormous sums that are continually being spent in reconnaissance, and would obviate a great amount of wasted effort. To this weighty statement we might add the enormous value of a good topographical map to all who are concerned in the government and administration of the country.

Another reason which makes the need of a topographical map of first importance is the question of geological survey. Geological information is deprived of a great part of its value until it is correctly plotted on a reliable map. Perhaps the best example and proof of this is the case of the Geological Survey of the United States. In that rapidly developing country it was felt that geological survey must be pushed on as fast as possible. The geologists found, however, that they must have good topographical maps; and there being none in existence, they set out to make them; with the result that the Geological Survey of the United States includes the topographical survey. In South Africa the same considerations apply with peculiar force; and it seems incredible in a country where geological survey and mineral development have such possibilities, that the value of a topographical map should have been so long ignored.

The present situation with regard to topography in South Africa is as follows: There is a good topographical survey (1 : 125,000 scale) of the Orange Free State, with an extension for a short way into the Transvaal. There is a 1 : 250,000 survey of Basutoland and of the northern part of the Cape Province. The latter is classed as a 'reconnaissance' survey; it is useful, but in Cape Colony at any rate scarcely adequate to the needs of the dominion. Of the remainder—about half of the Cape Province, almost the whole of Natal and the great bulk of the Transvaal—no topographical map exists. It will be seen that a vast amount remains to be done in the way of topography.

It is true that a start has been made with topographical survey of the country. The Director of the Trigonometrical Survey has been charged with this duty, and a sum of money has been allotted for it. The sum seems to an outsider, considering the immense amount of work which has to be done, to be extraordinarily small. It is something that the principle has been recognised, but no adequate progress will be made until a much larger sum is allotted. The question is also bound up to a large extent with that of staff. So far as I am aware, the Director of Trigonometrical Survey has no permanent staff for field work, and very little for work in the office. This is to be regretted. In my view a government survey ought to have a regular permanent staff; otherwise it is liable to have fluctuations in the quality and quantity of its work which are most undesirable. It may of course be convenient, and usually is in the early stages of a survey, to have in addition a certain number on a temporary basis. The same observations apply to the staffs of the surveyors-general. In all cases there should in my opinion be a staff of permanent government employees. All experience goes to support this view. The example of Canada may be quoted. Cadastral surveys there used to be put out to contract, but this was dropped in 1915, and I am informed that all the men engaged on survey work are now civil servants. It is to be noted that the Survey Commission laid particular stress on this point, especially in the case of the trigonometrical and topographical surveys.

The most satisfactory feature in South African survey is perhaps the triangulation; it is all of good quality, and is being pushed on as fast as funds will allow; but there is undoubtedly a great need of extension in the second and particularly in the third order triangulation. Some levelling has been done, but nothing as yet in the way of closed circuits; so that levels are at present, to use a common expression, hanging in the air. All surveyors know that it is impossible to check the accuracy of any levelling, and to distribute the errors, until the work has been closed on the starting point.

South Africa has a great survey tradition behind it. Some of the greatest survey schemes were started in this country; some of the finest survey work in the world has been done in it; and some of the best surveyors of the Empire have been trained here. South Africa ought not to be content to lag behind other nations in this matter.

Obituary.

Prof. S. B. Schryver, F.R.S.

BY the death of Prof. S. B. Schryver, which occurred on Aug. 21, an active worker in biochemistry—still in the prime of his intellectual powers—has passed away.

Samuel Barnett Schryver was born in London in 1869, the son of the late Lewis Schryver. He was educated at University College, London, and at Leipzig, his first appointment being that of assistant lecturer and demonstrator of chemistry at Liverpool. Afterwards he returned to London as lecturer on physiological chemistry at University College and chemist to the Research Institute of the Cancer Hospital. In 1913 he was chosen as assistant professor at the Imperial College of Science and Technology, and in 1920 he was appointed professor of biochemistry at the College. He was elected a fellow of the Royal Society last year.

About a hundred papers and notes stand to Schryver's credit. In 1890, in collaboration with Prof. J. Norman Collie, he showed that when a mixed quarternary ammonium chloride or hydroxide is heated, a mixed tertiary amine is produced, and in the following year he proved the existence of stereoisomeric quarternary ammonium compounds, thus confirming the view of Hantzsch and Werner. His work on the oxidation products of turpentine oil threw much light on the constitution of camphoric acid. Based on the fact that ammonia is liberated when sodamide and phenols interact, he devised a method of estimating these compounds. He worked on morphine, and studied the effect of feeding animals with thyroid.

Schryver's most important work was undoubtedly that connected with the proteins. He published a monograph on "The General Characters of the

Proteins" (Longmans' series) in 1909. In 1905 and 1906 the independent work of Schryver and Leathes proved that proteins are assimilated as amino-acids, the greater part of which is converted into urea by the liver cells and excreted by the urine. He was successful in applying Siegfried's carbamate method for the separation of the products of hydrolysis of the proteins, and by its means he was able to isolate several hitherto unknown substances. Among these may be mentioned oxylysine, $C_6H_{14}O_3N_2$, from isinglass, albumin of cabbage leaves, and edestin. Protoctine, $C_8H_{15}O_3N_3$, was obtained from oat protein.

Connected with his work on proteins, a series of ten papers on gelatin by Schryver and his pupils appeared between the years 1921 and 1927. The main object of this inquiry was to obtain a product of better technological value than commercial gelatin, and most of the work is therefore embodied in Reports to the Adhesives Research Committee of the Department of Scientific and Industrial Research. This work brought him into connexion with numerous firms manufacturing adhesives, to which he acted as consultant. Regarded as a whole, the work stands out not only from its industrial merit, but also as a notable contribution to pure chemistry, in which refined methods of physical chemistry were brought into use.

Gelatin was found to possess nearly all the properties of a globulin, but even when purified by treatment with 0·2 per cent caustic soda and by repeated flocculation in an electric field, it is shown not to be a chemical entity. When the purified substance is heated with water, treated with acids or alkalis, or repeatedly flocculated in an electric field, the hydrolytic products show an increase in the nitrogen that will not react with nitrous acid. Do not these observations of Schryver indicate the necessity of tempering our conclusions—drawn from the chemical substances we isolate from a given neutral product—with caution? The proteins, the polysaccharides, etc., exist in Nature in a form combined or co-ordinated with other substances.

In 1923 a communication was made from Schryver's laboratory showing that a crystalline carbohydrate can be separated from cabbage leaves in a yield of 0·01 per cent. It is non-reducing and its constitution is probably

$$CH_2OH \cdot CH(OH) - O - CH_2OH.$$

Several important papers emanated from Schryver's laboratory on the chemistry of pectins and their relation to the so-called hemicelluloses and other cell-wall constituents of plants. His work corroborated the ring formula assigned to pectic acid by work in my own laboratory. In 1910, Schryver found that formaldehyde is formed during the insolation of green leaves, but that it exists in combination with chlorophyll. In the course of this he improved Rimini's test for formaldehyde so that it became sensitive to a concentration of 1 in 1,000,000. Among researches in physical chemistry Schryver worked on the state of aggregation of matter and on clot formation, the latter explaining the formation of casein from caseinogen by rennet and the effect of salts.

Prof. Schryver was a man of great personal charm who endeared himself to all his colleagues and pupils. His work was essentially original, based strictly on experimental results without the slightest bias of convention.

ARTHUR R. LING.

WE regret to announce the following deaths:

Dr. J. R. Eckman, associate chemist in the U.S. Bureau of Standards and lecturer in physical chemistry at George Washington University, on Aug. 1, aged forty-one years.

Dr. H. C. Frankenfield, who was in charge of the river and flood service of the U.S. Weather Bureau, on July 31, aged sixty-six years.

Prof. W. H. Perkin, F.R.S., Waynflete professor of chemistry in the University of Oxford, on Sept. 17, aged sixty-nine years.

Dr. J. M. Purser, Regius professor of physic in the University of Dublin from 1917 until 1925, and author of a "Manual of Histology" and of numerous papers on physiology, pathology, and medicine, on Sept. 18, aged eighty-nine years.

News and Views.

IN commenting as we did in these columns in our last issue on Dr. Bonhoeffer's recent work on hydrogen, we should have directed attention to the fact that in NATURE of Feb. 2 this year (p. 160) we published an account of experiments made by Prof. J. C. McLennan and his co-worker, Mr. J. H. McLeod, that established the existence in liquid hydrogen of two distinct kinds of molecules. In these experiments it was shown that when liquid hydrogen was irradiated with the light from a mercury arc, Raman effects were obtained that indicated that both sets of molecules were set into oscillation with the same *vibration* frequency, namely, 4159 cm.$^{-1}$. One of the sets of molecules was, however, set *rotating* with a frequency of 354 cm.$^{-1}$, corresponding to a transition from a zero to a two-quantum rotational state, while the other was set *rotating* with a frequency of 588 cm.$^{-1}$, corresponding to a transition from a single-quantum rotational state to a three-quantum one.

THESE experiments showed that in liquid hydrogen we had some molecules in a zero-vibrational and zero-rotational state and others in a zero-vibrational and first quantum rational state. Intensity measurements showed that there were considerably more (at least twice as many) molecules in the second state than in the first one. The distinctness of the two states was emphasised by the fact that no Raman effects were obtained corresponding to $m = 0$ to $m = 1$ or $m = 1$ to $m = 2$ rotational transitions. Dennison, it is well known, in attempting to explain anomalies in the specific heat of hydrogen, had shown by the use of wave mechanics that hydrogen at low temperatures should be regarded as a mixture of two effectively distinct

sets of molecules defined as symmetrical and anti-symmetrical. It will be seen, therefore, that the experiments of Prof. McLennan and his colleague constitute a brilliant experimental confirmation of that view.

ON Sept. 30 occurs the centenary of the birth of Franz Reuleaux, who has been called the father of kinematics. Born at Eschweiler, near Aachen, he acquired his early engineering experience under his father, and then for four years he was a student at Karlsruhe, Bonn, and Berlin. In 1858, at the age of twenty-nine years, he became professor of mechanics and technics at the Zurich Polytechnic School, from which in 1868 he passed to the Berlin Technical Institute and then to the Technical High School at Charlottenburg. His first contribution to engineering literature was a paper written when he was a student on "The Resistance of Materials", in which he directed attention to the molecular stresses of metals and to the necessity of taking into account the limit of elasticity together with the breaking strain. The book by which Reuleaux is best remembered is that entitled "Theoretischen Kinematik", published in 1875; in the following year an English translation of this was published by the late Sir A. B. W. Kennedy, under the title "The Kinematics of Machinery". An indefatigable worker, a member of many associations, Reuleaux served on the juries of several international exhibitions, and his outspoken views on the quality of the German exhibits at the Philadelphia Exhibition of 1876 caused much heartburning in German industrial circles. With his countrymen Redtenbacher, Zeuner, and Karmarsch and others, Reuleaux did notable service in stimulating engineering enterprise and research, and in raising the standard of machine design.

ONE of the most difficult problems in connexion with television is to get the receiving and transmitting apparatus to move absolutely in step with one another. If the same alternating current network of supply is available, this can be done quite satisfactorily by two synchronous motors, without the necessity of providing a separate channel for synchronising purposes. It would be possible to use oscillating quartz crystals or tuning-forks, but the connexions are so complicated and the expense so great that they would be impracticable in television. This difficulty has been surmounted by J. L. Baird by utilising the current which illuminates the neon tubes producing the picture. The perforated disc is driven by a small motor on the shaft of which is mounted an iron disc with narrow teeth projecting from its circumference. The neon tube currents pass through two electromagnets. When the synchronism is perfect the teeth pass the magnets during the extremely brief dark intervals between one picture element and the next. During these intervals there is no current in the magnet coils, and thus they have no effect on the iron disc. We have seen the device working well when simultaneous speech and television was being demonstrated between two rooms of Baird's laboratory at 133 Long Acre, W.C.2. Television receivers of this pattern are being put on the market in Germany by the Fernseh A.-G., which is the Baird organisation in that country. We understand that similar apparatus will be available in Great Britain when the television broadcast service is in regular operation.

AT the conference of the Association of Special Libraries and Information Bureaux, held at Cambridge on Sept. 20–23, Mr. E. W. Ashcroft read a timely paper on our technical English vocabulary. Words describing half-understood engineering and scientific processes occur often in technical journals, but they cannot yet be said to form a part of our language. The time for standardising words of this kind has not yet arrived. In the engineering industry the standardising authority is the British Engineering Standards Association—the BESA. It has recently published a glossary of technical terms with the object of standardising the electrotechnical terms used in the British Empire. This provides the basis also of the British portion of an international vocabulary which is being prepared by the International Electrotechnical Commission. Several difficulties have arisen which are still the subject of discussion. For example, it was thought desirable to standardise so far as possible the ending 'or' when designating a piece of apparatus or a machine for accomplishing a definite purpose. The ending 'er' was to be applied to the person who carries out the operation. On investigation, however, it was found that this seemed only feasible with words of comparatively recent origin. Thus the spelling of condenser, controller, transformer, voltmeter, and many others still stand, but the names 'arrestor', 'convertor', 'selector', and 'startor', and others were adopted as the names of pieces of apparatus recently invented. Difficulties arose in connexion with trade names like 'megger' and 'ohmer'. The question is a thorny one. We do not agree that it matters little what usage is adopted so long as it is general. This, perhaps, is true of commerce, but it is for the common good to have a logical as well as a definite nomenclature.

THE new London broadcasting station at Brookman's Park, from which experimental transmissions are now being sent, is very conspicuous from the Great North Road between Potter's Bar and Barnet. It has four insulated masts; the more northerly pair support the aerial from which the broadcasts are being made, and the station is at present working on the normal 2LO wave-length. The power station is a large building covering three-quarters of an acre and is centrally situated with regard to the four masts. It contains four Diesel engines, each generating 300 horse-power. In the centre of the dynamo room are three machines, each capable of generating 160 kilowatts at any pressure between 7000 and 12,000 volts direct current. When the station is completed the other aerial will send simultaneously another programme on a different wave-length. Two machines will be working and one will be kept in reserve. Two small storage batteries are kept for heating the filaments of the valves, as it is essential to have no ripples in the current. Very special precautions are taken to maintain the

wave-length constant. At present the programmes are received by underground lines running from the studios at Savoy Hill on the Embankment. There are two sound-proof listening rooms at Brookman's Park, one for each transmitter, where the quality of the speech and music is checked by a loud speaker. In order to avoid the risk of accidents with aeroplanes in this district, and for other reasons, the Government limited the height of the masts to 200 ft. A red electric lamp at the top of each mast warns aircraft to avoid attempting to land in the neighbourhood. From the engineering point of view, much taller masts would have been more desirable.

THE London County Council, in connexion with the proposed large power station at Battersea, recently communicated with the Berlin Electricity Company asking for information about the Klingenberg Power Station. This is a very large power station (270,000 kilowatt), situated in a rather thinly populated district in the south-eastern suburbs of Berlin. In particular, the L.C.C. wanted to know whether nuisance was caused by ash, smoke, or sulphur fumes, and whether difficulties arising from these causes could be readily overcome. In its reply, the Berlin Company states that it has had practically no complaints in regard to sulphurous fumes, and that no harmful effects on health or vegetation had been observed. The latter effect, however, is difficult to detect until after long observation. The coal used has a small sulphur content, and possibly the coal used in Great Britain has a larger one. The German engineers believe the best solution of the problem lies in the use of higher chimneys. The chimneys at Klingenberg are 225 feet high, but in the new German power station near Liemenstadt the chimneys are nearly 400 feet high. The German company states that it has received many complaints about the floating ash and grit discharged from the chimneys. This comes down sometimes almost like a shower and causes much annoyance. The station burns pulverised fuel, which has a large ash content. Ash catchers of various kinds are now used which trap some eighty per cent of the floating ash. Experiments are being made with a water-washing process, in which the gases are forced through several 'veils' of water. A somewhat similar method is also being used to trap the sulphur fumes.

MARCONI'S Wireless Telegraph Co., Ltd., has obtained an order for a large extension of the Polish broadcasting organisation, which, following the English example, is to be remodelled so as to provide alternative programmes for the greater part of the country. The new equipment will comprise one 120 kw. aerial input broadcasting transmitter with full modulation, two high-power regional stations with 16 kw. aerial input, and three local relay stations. Provision will be made for simultaneous broadcast facilities throughout the whole of Poland, the relay stations transmitting on a common wave-length employing the tuning-fork system of control, such as has been in successful operation in Great Britain. The 120 kw. station will be situated near Warsaw and will be used in addition to the 12 kw. Marconi station which has been in operation there since 1927. It will take the wave-length of the present 12 kw. station, which is 1111 metres; and the 12 kw. station will work on a lower wave-length. The two stations will be employed simultaneously for the transmission of alternative programmes. The two new 16 kw. stations will be situated at Lemberg and Vilna to provide programmes for the areas outside the range of the lower-powered station at Warsaw. Of the three local relay stations, one will be situated at Lodz, the Polish Manchester, 80 kilometres from Warsaw, to provide an alternative crystal programme for a working-class district. Arrangements are being made for alternative programmes to be available from Warsaw before the end of this year, and the whole scheme is expected to be in operation before the end of 1930.

THE incidence of a further period of drought in south-east England directs attention again to the generally dry character of this year, especially in the Midlands and south-eastern portions of England. According to a statement issued by the British Rainfall Organization (Air Ministry), for the eight months January to August, small patches with half the average rainfall, or less, are found in Nottinghamshire, east Lincolnshire, round about the borders of Berkshire and Hampshire, and in the east of Kent. An area with less than 60 per cent of the average runs as a belt across England and Wales from Cardiganshire to east Kent, but whereas the belt is narrow at its ends, it broadens out considerably in the middle. To the south and south-west of this belt, the percentage values range from 70 to 88 along the south coast, east of Devonshire; to 85 in Pembroke, and to 92 per cent in south-west Cornwall. Another area with less than 60 per cent of the average surrounds the dry patches of Nottinghamshire and Lincolnshire. Between the two areas with less than 60 per cent the percentage values fail to reach 70 per cent except in North Wales, where they just exceed 80. In the north of England the percentage values are generally somewhat in excess of 70, and surpass 80 locally in north Cumberland and the North Riding of Yorkshire. In Scotland the percentage values for the eight months appear to vary between 70 to just above 90 per cent; in Ireland they range from a little more than 70 to just above 100 per cent in the west of Galway. For the country as a whole the dry weather cannot be compared as yet with that of 1921, when for the nine months February to October less than 50 per cent of the average was recorded over the whole of south-east England and a considerable part of the southern Midlands. However, September and perhaps later months also have still to be reckoned with, and it is premature to make a final pronouncement.

IN a paper read before Section E (Geography) of the South African Association for the Advancement of Science at its meeting in August, which is printed in the Johannesburg *Star*, Dr. Percy A. Wagner made an interesting contribution to the problem of the pre-European miners and smelters of South Africa. The ancient gold industry of Southern Rhodesia is well known, but it is less commonly known that the

Katanga district of Belgian Congo formed, with central and Southern Rhodesia and the north-eastern Transvaal, the greatest ancient copper fields, whilst tin was most extensively mined in the Roolberg district of the Transvaal, and iron was worked over a large part of the area. A map showing the distribution of the ancient workings was exhibited, it being explained that these ancient mines, characterised by a high degree of mining skill, are clearly distinguished from the rough native workings of the last few centuries. Nearly all the gold and most of the copper mines of the present time in South Africa are on the site of old workings.

OVER a large region, from Katanga to Zimbabwe, the copper ingots found were of the astragalus type usually associated with the Phœnicians. At least a million tons of copper and 2000-3000 tons of tin must have been extracted. Since so little has been found in the finished state, the product must have been mainly exported, and Dr. Wagner is of opinion that these mines were the chief source of the copper, bronze, and gold of Egypt, India, and western Asia. Dr. Wagner maintains that the ruins of Zimbabwe and elsewhere are the temples of the race which conducted the mining and smelting operations. The bronze and copper of the Waterberg district contain notable quantities of nickel, an element which is also characteristic of the copper of Egypt and Mesopotamia. A bangle from Zimbabwe is a true tin bronze containing nickel, and as no tin is known in Southern Rhodesia, it is presumed that the bronze came from Waterberg. The case presented by Dr. Wagner will no doubt receive criticism on several grounds, but the new facts are of great interest.

WHEN a future generation comes to setting down the history of the growth of scientific method in anthropology, few names will have a claim to rank higher than that of the late General Pitt-Rivers. Both in the study of development in material culture and in archæological investigation, he elaborated methods which lie at the foundation of all the work of the last forty or fifty years. Record of his own work is preserved not only in the magnificent volumes upon which he lavished time and money, but also his methods and theories are embodied in material form in the Pitt-Rivers Museum at Oxford and in the Pitt-Rivers Museum at Farnham. Further, in the latter the visitor may see both the objects which were discovered by his excavations in Cranborne Chase and elsewhere, and side by side an exact record of the excavations themselves. Carefully executed models show the sites before excavation and the completed result. The general purpose of the Museum at Farnham is to illustrate the life of peasant communities. Costumes, furniture, pottery, arts and crafts, and agriculture each have rooms devoted to their exhibition. This, however, does not complete the tale of the collection. One room is devoted to the objects excavated in the neighbourhood, and there are in addition the ethnographical objects collected by Pitt-Rivers after his earlier ethnological collections had gone to Oxford. These include the famous collection of Benin bronzes.

AN excellent and well-illustrated "General Handbook" to the collections has recently been published, which may be obtained from the Museum. It is edited by Mr. L. H. Dudley Buxton, who has been engaged in the rearrangement of the collections. He also contributes several descriptive articles. Others are by Mr. H. St. George Gray, who for ten years was secretary and assistant in the museum. He writes a biographical note on General Pitt-Rivers and describes the models of the excavations. Dr. Harrison writes on pottery; and Dr. R. R. Marett describes the ceremonial objects. Mr. F. Ll. Griffiths contributes a note on an Egyptian 'tombstone'. A chapter on the "Ancient Inhabitants of Farnham and its Neighbourhood" by the editor is in the nature of an excursus on continuity in English life and culture, and incidentally it is an object lesson on the right orientation of a local museum. The present owner, Capt. Pitt-Rivers, has generously thrown open the Museum for a vacation school in anthropology of which the first session was held last Easter. For this purpose no better instrument of instruction than the collections could be desired.

IN a Shaw Lecture delivered at the Royal Society of Arts and published in the Society's *Journal* for Aug. 30, Sir Thomas Legge, formerly H.M. Senior Medical Inspector of Factories, reviews his thirty years' experience of industrial maladies. The progress during this period has been amazing, due to notification, prohibition, and regulation in the industries concerned. Phosphorus poisoning in the form of 'phossy jaw' in match-making has disappeared owing to the substitution of sesqui-sulphide of phosphorus for yellow phosphorus. The incidence of anthrax has been halved by the application of disinfection of wool and hair and the use of exhaust fans in the factories. Lead poisoning has been reduced to less than half among white-lead workers and painters, owing to the recognition that the poison is absorbed by the lungs and the adoption of measures to prevent its inhalation. Skin cancers are relatively common among certain tar and pitch workers and cotton mule spinners, but in the early stages are curable, so that periodical medical examination would result in a considerable saving of life, and incidentally in the cotton industry a saving of a considerable part of the £10,000 now paid in compensation. With new industries new risks develop, and during the last few years carbon disulphide and hydrogen sulphide poisoning have occurred in connexion with rubber and artificial silk.

THE University of London Observatory at Mill Hill Park will be opened and the Wilson telescope unveiled by the Astronomer-Royal, Sir Frank Dyson, on Oct. 8 at 3 P.M.

AT the sixth annual conference of the Association of Special Libraries and Information Bureaux held at Cambridge on Sept. 20–23, Sir J. J. Thomson was elected president of the Association in succession to the late Sir Geoffrey Butler.

THE inaugural sessional address of the School of Pharmacy of the Pharmaceutical Society of Great Britain will be delivered on Oct. 2 by Prof. Henry

Hurd Rusby, professor of materia medica in the College of Pharmacy, University of New York, when the Hanbury Gold Medal of the Pharmaceutical Society will be presented to Prof. Rusby. A note on Prof. Rusby's life and work appeared in NATURE of June 1, p. 845, in announcing the award of the Hanbury Gold Medal.

MR. F. D. OMMANNEY, Mr. F. J. Hart, and Mr. A. H. Laurie have been appointed to zoological posts on the scientific staff of the Discovery Committee. Mr. Ommanney has already left England to undertake whaling investigations with Mr. J. F. G. Wheeler at the Marine Biological Station, South Georgia. Mr. Laurie is joining the R.R.S. *William Scoresby* at Cape Town, and Mr. Hart will sail towards the end of the year in the R.R.S. *Discovery II.*

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A full-time head of the Mechanical and Electrical Engineering Department of the Harris Institute, Preston—The Principal, Harris Institute, Preston (Oct. 1). An assistant in the Mechanical Engineering Department of the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Oct. 1). A head of the Pharmacy Department and a full-time assistant lecturer in engineering at the Cardiff Technical College—The Principal, Technical College, Cardiff (Oct. 5). An inspector under the Alkali, etc., Works Regulation Act, 1906—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Oct. 5). An Astley Cooper assistant to the Curator of the Gordon Museum of Guy's Hospital Medical School—The Secretary to the Astley Cooper Trustees, Medical School Office, Guy's Hospital, S.E.1 (Oct. 7). A research assistant in engineering applied to glass technology, in the Department of Glass Technology of the University of Sheffield, and research fellowships in glass technology in the same department—The Registrar, The University, Sheffield (Oct. 14). An assistant in botany in the University of Aberdeen—The Secretary, The University, Aberdeen (Oct. 15). An assistant professor in electrical engineering at the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, South Kensington, S.W.7 (Nov. 1). A technical assistant in the Physics Department of the British Boot, Shoe, and Allied Trades Research Association—The Director of Research, British Boot, Shoe, and Allied Trades Research Association, 19 Bedford Square, W.C.1. A full-time lecturer in mathematics at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A woman lecturer in education in the department for the Training of Teachers of the University of Reading—The Registrar, The University, Reading. A lecturer and adviser in veterinary science in the Harper Adams Agricultural College and National Institute of Poultry Husbandry—The Principal, Harper Adams Agricultural College, Newport, Salop. A Principal of the Derby Technical College—The Secretary to the Derby Education Committee, Education Offices, Becket Street, Derby.

Our Astronomical Column.

Comets Neujmin and Forbes.—The following elements of these comets have been computed by Dr. A. C. D. Crommelin; the first from observations on Aug. 4 and 31 (Königstuhl) and Aug. 15 (Lick); the second from photographic observations at Johannesburg by H. E. Wood on Aug. 3, 8, 13. The equinox is 1929·0; T is in U.T. :

	Neujmin.	Forbes.
T	1929 June 28·922.	1929 June 26·619.
ω	140° 45′ 50″	260° 18′ 39″
Ω	158 15 53	25 5 38
i	3 40 23	4 39 34
ϕ	35 38 12	33 51 12
$\log q$	0·309227	0·185458
Period (years)	10·7914	6·4370

Almost identical elements of Forbes's comet were found by Dr. R. T. A. Innes using the same observations. He notes that they indicate a close approach to Jupiter at the aphelion passage of 1920. There is a slight resemblance to the elements of Barnard's Comet 1884 II. A period of 5·4 years was found for it, but it has not been seen since its first apparition.

The Discovery of Proxima Centauri at Johannesburg.—An account is given in the Johannesburg *Star* of Aug. 24 of the circumstances which led to the discovery of the sun's nearest stellar neighbour. It is emphasised that the discovery was no fluke, but that Dr. Innes, noting other cases of distant companion stars, had an inspiration that Alpha Centauri might have such a companion. The circumstances recall Prof. W. H. Pickering's successful search for Phœbe, the distant satellite of Saturn; in that case also there was a sort of inspiration that such a body existed.

There were to hand the photographs of the region taken by Mr. Franklin Adams at the Cape in 1902, and similar photographs taken with the same instrument at Johannesburg in 1910. Further, a blink microscope for comparing star plates had been procured for the Observatory in 1915. At Dr. Innes's request, Mr. Wood took a further photograph of the region in 1915, under exactly the same conditions as the 1910 one. Comparing these plates, Dr. Innes quickly detected a faint star that had changed its position very obviously in the interval of 5 years; further examination showed that its motion was very nearly equal and parallel to that of Alpha. The connexion was further established by the determination of the parallax of Proxima, both at Johannesburg and by Dr. Voute. In the last few months a further determination has been made by Dr. Alden at the Yale station at Johannesburg; these determinations all agree in indicating that the distances of Alpha and Proxima are nearly the same, the latter being slightly nearer to us; the distance from Alpha is so great that the period of revolution must be of the order of a million years; but there is little doubt that Proxima and the two components of Alpha form a connected system.

General Perturbations of Minor Planets by Jupiter.—E. de la Villemarqué, *S.J.*, has computed tables of the perturbations by Jupiter of a large number of minor planets: he is now engaged on the planets whose mean daily motion lies between 1250″ and 1350″. *Astr. Nach.*, 5654, contains the first instalment for these planets. The labour of keeping up the positions of more than 1000 planets is so heavy that any tables that shorten the work deserve a hearty welcome.

Research Items.

Marriage in Africa.—From an extended study of the principles of Bantu marriage, Mr. E. Torday in *Africa*, vol. 2, No. 3, draws certain conclusions as to its essential features and directs attention to their practical bearing. In the present state of our knowledge, Bantu marriage appears to be the marriage of one man and one woman for the begetting of legitimate children in whom one of the two souls of the parents is perpetuated, and these will, after their parents' death, perform for them the rites and offer to them the sacrifices on which their happiness in the world of spirits depends. This is based upon a contract between two freely consenting adults whom it binds to conjugal fidelity on pain of temporal and spiritual penalties. It is indissoluble and liable to be extended beyond the grave by proxy if necessary to secure offspring. This arrangement has been disturbed by polygyny, which has affected the balance of the sexes, withdrawing a number of nubile females from the marriage market, and lowering the marriage age, leading further to a deterioration of sexual morals and adultery and divorce. 'Earnest', originally a symbol, is assuming more and more the character of a price on the bride. In its practical aspect this has led to a legal recognition of polygyny and a lower age for marriage than Bantu custom sanctions. Infant betrothal should be forbidden by law; nor should the growth of lobolo be allowed to pass unchecked into purchase money.

Chippewa Customs.—*Bulletin* 86 of the Bureau of American Ethnology is a study of the Chippewa by Frances Densmore, a number of whose valuable monographs on the music of different Indian peoples have already appeared in the publications of the Bureau. The writer first began her studies of the Chippewa in 1915, when she visited the villages on the north shore of Lake Superior, and since that date further material has been collected both in Canada and Minnesota on different occasions up to 1925. The present monograph covers the religion, social life, and technology of the Chippewa. Their name, Chippewa, is comparatively modern, and though it is the only name which has been used by Government in its relations with the people, is never that used by themselves; they still use the name Ojjibeway, or the older term A'nicina'be, meaning 'the original or first man'. They are described as a pleasant people with a strong sense of humour. Their industrial life was characterised by co-operation between men and women, the men taking the heavier part of the women's work, and the women assisting in the lighter part of the men's work, such as the making of canoes. Even the children assisted in such parts as they were able to perform. They maintained a high standard in their work, and those who excelled were honoured. Marked skill was held to be of supernatural origin. They early came into contact with white civilisation, and of them it was recorded that they "cultivate corn and potatoes to a limited extent, but devote most of their time in quest of food in the chase or in fishing". Their tribal history is recorded in the traditions of the Midewiwin (Grand Medicine Society) traced down from one generation to another. There are records of a migration from the great salt waters of the east, westward to the place where Montreal now stands, then to the shores of Lake Huron, and finally to La Pointe (Superior), where the Lodge was erected for the last time before the coming of the whites.

A Census of Gannets.—Several estimates, based upon different grounds, have been made of the number of solan geese or gannets which breed annually upon the Bass Rock in the Firth of Forth. The estimates have given numbers varying from 5600 to 10,000 adult birds, a fairly wide range. The first actual count of the gannets is described and discussed by Dr. James Ritchie in a recent issue of the *Scottish Naturalist* (p. 127). It was made by one of the light-keepers during the present summer, and revealed the presence of 4047 gannets' nests, representing 8094 adult breeding birds. In addition, 100 pairs were nestless owing to the raids of herring gulls—which gives a total adult breeding population of 8294 individuals. It is suggested that although the gannet population may have varied from year to year through the centuries, various factors make it probable that at present the numbers are at their greatest.

Migrations of British Woodcock.—In the days of the older naturalists, emphasis was laid upon the migrations of British woodcock, although it was admitted that occasional individuals remained over winter in Great Britain. Nowadays the ringing method of following the movements of birds has thrown the emphasis upon the woodcock which remain throughout the year in the British Isles. As a result of an analysis of the recaptures of ringed woodcock, Dr. Landsborough Thomson finds that perhaps only one-third of Scottish and North English birds migrate, and that the number recaptured on their native ground, often after a lapse of several years, is a striking feature of the data (*British Birds*, September, p. 74). There is a regular autumn movement from Scotland to Ireland, and also to France and Spain. About 95 per cent of the recovery records relate to the first four years of life, but it is interesting to find that one individual had reached the age of 12½ years before it was shot, while a few others ranged from 8 years to 12 years old. There is no positive evidence that migrant woodcock return to their native localities; indeed one individual ringed in Ireland was found, when two years old, in southern Norway.

Californian Echinoderms.—The second Bingham Oceanographic Expedition collected some very interesting echinoderms, including seven species of starfish, nine species of echinoids, three of ophiurans, and one holothurian ("Echinoderms from the Gulf of California and the Perlas Islands", by Lee Boone. Scientific Results of the Second Oceanographic Expedition of the *Pawnee*, 1926. Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University, vol. 2, art. 6, December 1928). These are described with beautiful photographic illustrations. Perhaps the most valuable capture was the large holothurian belonging to the Synaptidæ, presumably to be attributed to the West Indian species *Euapta lapha* (J. Müller). Three specimens were taken at night from Hidden Harbour, Lower California, each bearing 15 tentacles and having anchor plates which are identical with those of specimens taken at Porto Rico. Other distinctive finds are the big urchins *Meoma grandis*, only known from the Gulf of California and West Mexico, the peculiar *Encope grandis*, the 'key-hole urchin' of the Gulf of California, of which 23 specimens were taken, *Encope californica* with its five ambulacral foramina and one posterior foramen, and *Astropyga pulvinata*, one of the Diadematidæ. This last species is rare, and the *Pawnee* material appears to be the first record from Conception Bay.

Phylogeny of the Primate Placenta.—In a study which has covered the examination of 31 specimens

of 5 species of New World and 7 species of Old World monkeys, G. B. Wislocki has obtained evidence that the placentæ of the *Simiæ* exhibit various arrangements in structure which show them to be different and yet to possess certain definite relationships (Carnegie Institution, *Contributions to Embryology*, vol. 20, No. 111, 1929). He concludes that the lower catarrhines exhibit an architecture of the placenta intermediate between the platyrrhines and the anthropoids, a sequence of development which would agree with that based upon comparative anatomy. A survey of the literature of mammalian placentation suggests that the majority of the mammals which are archaic or are not far removed from the direct line of descent possess deciduate placentæ, whereas the animals which possess a diffuse type of placentation are amongst the most extremely specialised mammals. This suggests that the deciduate type of placenta is probably the most primitive and that the diffuse placenta is a specialised offshoot from it. The protoplacentals themselves were derived from oviparous forms, so that naturally there must have been a period of transition from oviparity to viviparity, during which a diffuse apposition of the membranes to the uterine mucosa might well occur. But recent placentals, as well as their fossil prototypes, do not derive the diffuse condition of their placentæ from such primitive transition forms. They appear to be quite independently and secondarily derived from mammals which possessed penetrating trophoblast.

Leaf Growth in the Giant *Euryale*.—The circular floating leaves of *Euryale ferox* vie in size with those of *Victoria regia*, the largest being a metre and a half in diameter. According to Yonosuke Okada (*Sci. Rep. Tôhoku Imp. Univ.*, **4**, 361-368; 1929), their horizontal extension takes place in less than nine days, and the rates of growth may therefore be exceptionally high, even for water plants. Measurements indicate that the leaves may increase in diameter by more than 1 cm. in an hour, giving increases in area of 100-150 sq. cm. per hour, for the period of most rapid growth. The growth rates are fairly uniform during both day and night, although tending to be higher during the day. The ratio mass/area decreases as the leaves get older.

Chromosome Linkage in *Œnothera*.—A further study of chromosome arrangement during meiosis in *Œnothera* has been made by F. M. Sheffield (*Proc. Roy. Soc.*, B, **105**, 207-230; 1929) with particular reference to linkage in a series of F_1 hybrids with fourteen chromosomes. Most of the chromosomes were arranged in a ring with a variable number of free pairs. Non-disjunction was frequent, being observed in about 9-12 per cent of the examples. In a further consideration of the available data, the author points out that wild species of *Œnothera* have either a large amount of pairing or more commonly a large amount of linkage, the mutants and hybrids being generally intermediate, though the type of linkage found in *Œ. Lamarckiana*, a ring of twelve and a single pair, is by far the most common. His analysis of these data shows that chromosome configuration in hybrids is the same as that of the pollen parents in seven cases, and as the seed parents in five cases. In one example, both parents and hybrids were alike, while in the remaining fourteen cases the hybrids differ from either parent. It is pointed out that these figures are not contrary to the supposition that chromosome linkage is inherited, the whole problem of linkage and its bearing on the genetic peculiarities of *Œnothera* being fully discussed.

Natural Distillation of Oil-Shale.—The possibilities of oil-shale seem to be infinite, judging from the vast literature devoted to it, but the following presents an unusual though not exactly new view-point. A well drilled on the north flank of Wheeler Ridge, south end of San Joaquin Valley, California, penetrated a considerable thickness of oil-shale. Of the many oil and gas shows in this well, all were confined to the shale belt. The zones of oil production in the main part of the oilfield concerned correspond approximately in stratigraphic position with the shale development described, and accordingly the question arises as to whether by natural distillation the oil obtained in the producing area is not directly derived from the lateral shale instead of from deeper lying beds, as commonly imagined. If Mr. H. W. Hoots has made his case for this possibility good, and there is certainly something to be said for his theory; then his remarks (*Professional Paper* 154-E, 1929, p. 173, United States Geological Survey) are worthy of notice and debate: "It would appear that if typical oil-shale will yield petroleum under natural conditions which have prevailed since its deposition, any stratigraphic zone of oil-shale or other highly organic rock, whether of marine or lacustrine origin, and even though entirely devoid of recognisable fossils, should be considered an adequate source of petroleum deposits in areas where overburden has been great or where deformation has been intense".

Mean Sea-level.—During the last two years, studies of mean sea-level have been carried on in New York waters under the direction of the National Research Council of the United States. Prof. D. Johnson has communicated a preliminary statement of the results to the *Geographical Journal* for September. Jamaica Bay, on Long Island, was selected for the study, the object of which was to test the theory that along an irregular coast mean sea-level is an irregular surface the precise elevation of which varies with changes in the form of the shore. Results showed the tidal range to be greater within Jamaica Bay than in the more open Lower Bay adjoining. They also show mean sea-level to be higher in Jamaica Bay than in Lower Bay, and the plane of sea-level to be higher at the north-eastern than at the southern and western stations. Prof. Johnson feels that the results support the view that distortions of the mean sea-level may be inferred from a consideration of the physiography of a given shore line. A full report is promised shortly.

Thames Floods and High Tides.—A report on the Thames floods of January 1928, by Dr. A. T. Doodson, and meteorological conditions associated with high tides in the Thames, by Mr. J. S. Dines, are the two papers published in *Geophysical Memoir*, No. 47, issued by the Meteorological Office. It appears from an exhaustive analysis of water-levels and meteorological conditions during recent years that the conditions under which the water-level rises by 4 feet or more above the predicted level at Southend are clearly defined. They are the onset of a geostrophic wind over a considerable part of the North Sea of 60 m.p.h. or more from between north-west and north. Within seven to sixteen hours, such an onset is likely to be followed by a considerable rise in water-level. A westerly wind with no north component over the extreme southern North Sea is no bar to a raised water-level so long as the requisite north-west to north wind occurs over other parts of the area. A favourable prior occurrence appears to be either a westerly gale off the west of Ireland and Scotland which veers or dies away before the onset of the wind over the North Sea, or a southerly gale over the North Sea preceding the northerly wind. During fifty years, only one serious flood has occurred. This is because

the rise above the predicted level only causes floods when it coincides with high spring tide. It has been found that the abnormal rises tend to occur at half tide, when they can do no harm. The reason for this avoidance of full tide has not been discovered, but its existence very materially reduces the liability to serious floods.

Sound Vibrations.—The issue of the *Journal de Physique* for May contains an article by M. Z. Carriére, of the Catholic Institute of Toulouse, on the study of the movements of the air when transmitting a sound wave. The air in a metal tube 3·5 cm. diameter and 170 cm. long is set into vibration by a telephone diaphragm which closes one end, the other being also closed. Fine dust can be blown into the tube and can be illuminated through a window in the side of the tube near the middle of its length. A microscope of low power allows the points of light produced by the dust particles to be observed through a second side window. When there is no obstruction in the tube the particles describe straight line paths parallel to the axis of the tube of length varying from 0·15 mm. to 1·8 mm. according to the current used to operate the telephone diaphragm. When a cylinder is present in the tube with its axis at right angles to that of the tube, the paths near the surface of the cylinder are small ellipses with their long axes in the direction of the stream lines in the motion of a perfect fluid past the cylinder. As the amplitude of the motion increases, these ellipses become pointed as they approach the plane through the axis of the cylinder at right angles to the axis of the tube.

Volta Effect.—From time to time Prof. Oscar Scarpa, of the Royal Milan Polytechnic, has carried out theoretical and experimental investigations on the Volta effect, with the object of applying to it present-day knowledge of the chemico-physical constitution of metals and alloys. At the meeting of the Reale Istituto Lombardo di Scienze e Lettere on April 11, he gave a preliminary account of certain phenomena observed in circuits composed entirely of metals. With reference to the first part of Volta's law relating to the potential differences developed at the contacts of different metals, Prof. Scarpa finds that if a chain of metals includes some capable of mutual reaction, the order of arrangement is not without influence on the magnitude and sign of the potential difference between the extremes. Thus, although with the system copper-mercury-copper-zinc-copper zero potential difference results, this is not the case with copper-copper-mercury-zinc-copper. As regards the second part of Volta's law, it is not correct to state merely that, with heterogeneous metallic chains having any given temperature, the terminal potential difference depends solely on the chemico-physical nature of the component metals. A necessary condition for this to hold is that all the metals in contact must be indifferent one to the other.

Spectrum of Krypton.—The July issue of the *Journal of Research* of the United States Bureau of Standards contains a paper by W. F. Meggers, T. L. de Bruin, and C. J. Humphreys on the arc spectrum of krypton. This had not previously been described satisfactorily, largely, it would appear, because of the difficulty of distinguishing between the lines of krypton and those of xenon. Some two hundred lines are listed, and the majority of these have been fitted into term schemes, which, as would be expected, are similar to those of neon and of argon. This investigation was undertaken primarily in order to test the possibility of using the krypton line at 5650 A. as a standard of wave-length in place of the red cadmium line. The term analysis actually shows that the former involves a metastable state of the atom, so that it is unsuited for this purpose, although a stronger krypton line at 5871 A. is free from this objection, and is to be re-examined for hyperfine structure. The paper includes a bibliography of earlier work upon the spectrum of krypton, and good reproductions of the arc spectrum between 3300 A. and 9751 A.

Preservation of Metal and Timber in Sea-Water.—The committee of the Institution of Civil Engineers which is investigating the deterioration of structures in sea-water has issued its ninth Interim Report, published by H.M. Stationery Office for the Department of Scientific and Industrial Research (London. Price 3*s*. 6*d*. net). The Report follows the same lines as its predecessors, being occupied mainly by records of the loss of weight and extent of pitting of specimens of iron and steel exposed in various situations. Dr. J. N. Friend describes the bars which have been exposed for five years at Plymouth and Colombo respectively, the corresponding sets exposed at Auckland and Halifax having been reported on last year. In general, the four sets are in fairly good agreement. Completely immersed specimens show less difference than those exposed to alternate wet and dry conditions, whilst aerial exposure gives the greatest differences between the best and the worst specimens. Nickel has a marked effect in lessening the corrosion of steel, and highly alloyed steels are very resistant, although steel with 13 per cent of chromium is badly pitted when continuously immersed. The alloy steels do not happen to be very typical of the corrosion-resisting steels of the present day, this being a consequence of the long period necessarily occupied by such trials. It cannot be said that the tests have brought to light anything very novel, and they will be best interpreted in the light of the scientific work on corrosion now being conducted with so much success. The effect of various paints and coatings is still under investigation, and the results of this work will be useful. Prof. G. Barger reports on the protection of timber by impregnation with arsenical poisons, and finds that low concentrations give insufficient protection against *Teredo*, whilst uniform impregnation is not easily effected. *Limnoria* is proof even against the highly poisonous arsenical preservatives, but certain woods appear to be immune from its attack.

Canadian Hydro-electric Development.—The development of hydro-electric power in Canada continues to make rapid progress. The mid-year review of the Department of Water Power and Reclamation Service, just issued by the Minister of the Interior at Ottawa, shows that during the first six months of 1929 new undertakings completed and additions made to existing installations have totalled an aggregate of almost 200,000 horse-power. The undertakings at present in hand, when completed to the limit of their designed capacity, will produce more than two million horse-power. As was stated in an article which appeared in NATURE of July 27, p. 130, the total hydro-electric horse-power actually developed in the Dominion is now about 5½ millions. Activity is particularly notable in the provinces of Quebec and Ontario, where several important enterprises are being prosecuted. The only province in which progress is not marked is Prince Edward Island. The laying of transmission lines is an outstanding feature, including a second 220,000-volt line from the Gatineau River to Toronto and a 132,000-volt line across New Brunswick.

Freshwater Fauna of the Malay Peninsula.

By CEDRIC DOVER.

VERY little is known of the freshwater fauna of the Malay Peninsula, though the late Dr. N. Annandale, the father of freshwater biology in the East, extended his studies outside Indian limits. A beginning is, however, being made in Malaya, as the institution of a series entitled "Papers on Malayan Aquatic Biology" in the *Journal of the Federated Malay States Museums* proves, and it is the object of this note to indicate the general interest of the subject.

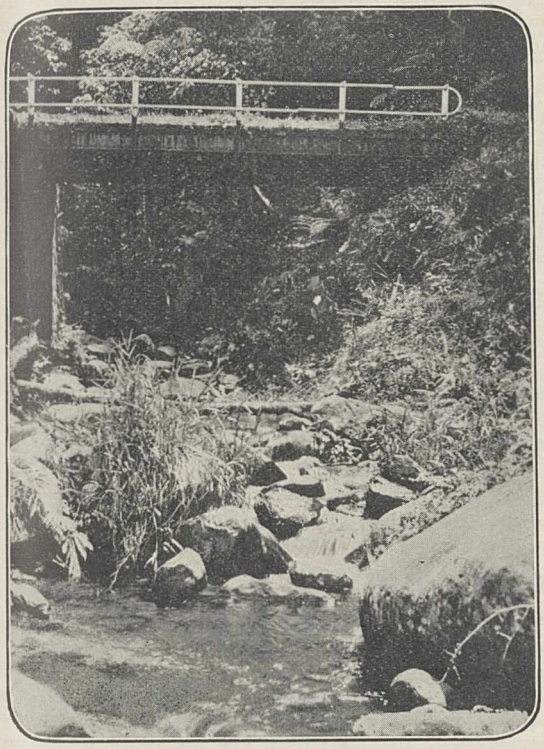

FIG. 1.—A hill-stream in Selangor showing the rocky bed and the quiet areas formed by the rocks.

Comparing the Malayan freshwater fauna with that of India, one is struck with its poverty from the viewpoint of specific variety. Insects, of course, are abundant, particularly the aquatic Rhynchota (of which a very large and thorough collection has been made), mosquitoes, dragon-fly and various neuropterous larvæ, and coleoptera, especially the Hydrophilidæ and Gyrinidæ. Such groups as the fishes and tadpoles, however, though they occur in Malayan ponds and streams, are not abundant either specifically or individually, while molluscs are rare, and only one polyzoon, and no hydrozoa or sponges, has yet been found.

In the hill-streams the surface fauna consists entirely of water-bugs of the family Hydrometridæ, particularly the long-legged striders of the genera *Ptilomera* and *Metrocoris*, with occasionally one or two species of gyrinid beetles which swarm in the quieter areas at the edges. There are no other visible planktonic organisms. Below the surface the only fauna, except in still areas caused by a large boulder or a bend in the stream where fishes are found in some abundance and a few Notonectidæ sometimes occur, is that attached to stones and rocks on the bottom. This fauna consists chiefly of the larvæ of certain mayflies, dragonflies, and Pyralid moths, and the curious tadpoles of the genus *Megalophrys*. Among vegetation at the edges, or among rocks in the quieter parts (Fig. 1), prawns and, more rarely, molluscs of the genus *Melania* may sometimes be seen, while leeches are often abundant enough to be troublesome.

The fauna at the source of the stream presents little essential difference from that found in its lower reaches, and the fauna of any one stream, on the west coast at any rate, is similar to that of any other stream, even though they be widely separated in distance. This is not surprising, for physico-chemically nearly all these streams are similar, their hydrogen ion concentration, for example, being always in the immediate neighbourhood of the standard of neutrality, while their temperature does not as a rule vary by more than two or three degrees Centigrade. Their rate of flow is usually very swift and the food supply afforded by them is so scarce that much specific variety cannot be expected, for only a few species, prolific in reproduction and having a short life-history, can establish themselves in these streams. The well-established forms are therefore characterised by an abundance of individuals, the collector often being able to obtain a few hundred specimens of such species as the hemipteron *Perittopus breddini* with a single sweep of the net. But while the fauna of Malayan hill-streams is poor, it is of absorbing interest, and this very poverty, combined with the abundance of easily accessible streams, would facilitate intensive studies along the lines of Annandale and Hora's work in India and Dodd's researches in America.

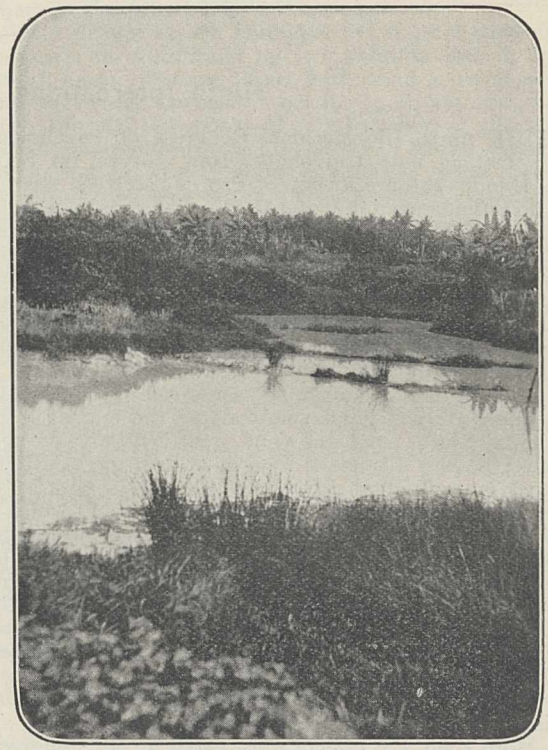

FIG. 2.—A swamp on the outskirts of Kuala Lumpur, divided off by Chinese agriculturists, showing nature of vegetation.

Turning to the biota of still-water areas, we find the same comparative paucity of species so far as the animals and higher plants are concerned, but a rich

algal flora. In the ponds the aquatic Rhynchota are also the most conspicuous organisms, being represented by all the known families, especially the Gerridæ, Microveliadæ, Notonectidæ, (*Plea* and *Nychia* especially), Corixidæ (*Micronecta* only), and the smaller Belostomatidæ (*Sphærodema rusticum*); the Nepidæ are comparatively rare. Coleoptera, mostly Hydrophilidæ, are quite common, while dragon-fly and dipterous larvæ, chiefly those of the Culicidæ and Chironomidæ, and shrimps, are usually abundant. Molluscs are rare, though occasionally a dirty Chinese duck-pond may be found in which Ampulariidæ, Viviparidæ, Milaniidæ, Limnæidæ, and Planorbidæ occur in fairly large numbers. Nematodes and oligochætes are scarce, and the polyzoa, hydrozoa, and sponges are entirely absent. The microscopic fauna is abundant, though not very varied, the Entomostraca being particularly common. Rotifers occur in some numbers, and there is generally a rich Protozoon fauna, *Euglena* forming a thick scum on the surface of some ponds.

The algal flora is rich, especially in blue-green algæ and in desmids, but the higher plants are generally rare and are often absent. In some swampy ponds there is a dense growth of rushes, weeds, and grasses at the edges (Fig. 2), consisting of such species (kindly identified by Mr. R. E. Holttum) as *Enhydrias angustipetala* Ridley, *Limnophila erecta* Bentham, *Cyperus hespari* Linn., *Rhynchosphora aurea* Vah., *Tuviena umbellata* Rottb., *Scirpus mucronatus* Linn., *Mariscus microcephalus* Pusl., and *Eleocharis variegata* Kunth., while in others the water-hyacinth, *Eichornia crassipes*, is very common. *Pistia stratiotes* is also sometimes abundant, while below the water at the edges the bladderwort, *Utricularia* sp., and the peculiar star-shaped *Blyxa malayana* Ridley may often be found.

The specific paucity of the macroscopic pond biota may be accounted for by the fact that many of these ponds are situated in limestone, and are thus detrimental to the life of such organisms as molluscs or sponges, while the water is generally very impure and varies from extreme acidity to extreme alkalinity, owing usually to the proximity of Chinese dwelling-houses and piggeries.

Sponges are entirely absent, and so are Polyzoa, with the exception of *Plumatella emarginata* Allman, which I have taken in the Ampang Waterworks near Kuala Lumpur, where the conditions for Polyzoon life are ideal. But even *P. emarginata* is living on the edge of extinction, though it seems to have the inherent hardihood which enables an organism to stand a certain amount of what Grinnell, the American ornithologist, so aptly calls ecologic punishment.

Of other freshwater areas on the west coast of the Malay Peninsula there is little to say. There are no natural lakes, and the larger rivers, which are often fouled with the tailings from tin mines, have not been carefully investigated. It is well known, however, that they are infested with crocodiles, while the insect fauna is more or less similar to that of the hill streams. The fauna of the mouths of these rivers is essentially marine.

Ninth International Congress of Psychology.

THE ninth International Congress of Psychology met at Yale University, New Haven, on Sept. 1–7 under the presidency of Prof. J. McKeen Cattell. The attendance numbered 1089 professional psychologists, of which, however, only 122 came from countries outside the United States. But this is not surprising when it is remembered that more than one hundred institutions in the United States provide for psychology an annual budget of £1500 or more, and that for the larger universities this figure averages about £10,000, and reaches its maximum of £40,000 at Columbia.

The president, doyen of American psychologists, outlined the colossal development of the subject in the United States since the time, nearly fifty years ago, when he was a pupil of Wundt at Leipzig. Cattell's work on individual differences will always rank as an outstanding pioneer achievement in this field which is now so universally systematised. Tables were presented which showed the number of contributions by the psychologists of the various countries during particular periods, and, as might be expected from the foregoing remarks, they demonstrated the quantitative and financial superiority of the United States. More interesting would be tables showing what percentage of the total population in each country consisted of professional psychologists.

More than 470 papers were listed at the Congress, and they covered all the various cross-divisions of psychology: theoretical, experimental, comparative, social, educational, industrial, æsthetic, religious, legal, physiological, etc. Sessions were also devoted to special topics such as the effects of drugs, sleep, the psycho-galvanic reflex, the psychology of music, and the nature of *g*.

In addition to researches on traditional lines, there are at least two branches in the United States which at present are carrying on research at high pressure. The first is that of animal behaviour, which was represented by thirty papers at the Congress. Several of the chief universities, such as Chicago, Clark, Columbia, Harvard, Michigan, Minnesota, Stanford, and Yale possess well-equipped laboratories for comparative psychology, although it is yet too early to attempt an assessment of the importance of their numerous studies. One of the chief workers in this field is Prof. K. S. Lashley of Chicago, the present president of the American Psychological Association, whose address on "Basic Neural Mechanisms in Behaviour" was acknowledged as a masterpiece, and showed further that not all workers in this field can be classed as narrow-minded behaviourists.

The second branch which displays marked activity is that of child development, especially prominent being the child research centres of the Universities of Columbia, Iowa, Minnesota, and Yale. The mode of attack appears to be a co-operative study by psychiatrists, psychologists, physiologists, anatomists, bio-chemists, and statisticians armed with elaborate machinery. They work at a common centre, usually attached to a university. It may be true that many of the results obtained are already known in general terms to our clinical experts. Nevertheless, the careful tabulation by exact statistical methods may still be worth while and may well repay the labour and expense entailed and lead to results as important as they are unexpected. Certain it is that the American nation intends to leave no stone unturned in order to ensure that the rising generations and their successors will not lack any physical or mental benefit which modern science can supply.

Prominent amongst European leaders present at the Congress may be singled out Prof. I. P. Pavlov, whose public lecture, "A Brief Sketch of the Highest Nervous Activity", was lucidly interpreted by Dr. G. Anrep;

Prof. C. E. Spearman, whose noegenetic theories are steadily gathering adherents, and Profs. W. Köhler and K. Koffka, who have gained many sympathisers for the *Gestalt* movement. Another German school which was in evidence at the last Congress at Groningen, namely, the *Erklärungs* group, was not represented at the Congress, although it is still a force in Germany.

A contribution which aroused lively discussion was Prof. W. McDougall's second report on a Lamarckian experiment, the first report having been presented at the Oxford meeting of the British Association in 1926. His experiments have been in progress for several years and are being continued. Definite problems were set to groups of white rats, that is, trained and control groups. While the average error for the control group was 165, this figure was reduced to 68 at the thirteenth generation of the trained rats and steadily diminished to 25 for the twenty-third generation. Prof. McDougall therefore concluded that the evidence in favour of the Lamarckian hypothesis was very strong.

The foreigners present were unanimous in their appreciation of the wonderful hospitality of the American people and of the gracious manner in which that hospitality was extended.

In conclusion, it may be pointed out as significant that President James R. Angell of Yale, Prof. Cattell, and Prof. F. Claparède of Geneva, the secretary of the international committee of the Congress, in their opening addresses, all emphasised the part which the Congress has already played in cementing goodwill and peace amongst the various nations. An official address of welcome on behalf of the United States Government was given by Mr. William J. Cooper, Commissioner of Education.

Annual Exhibition of the Royal Photographic Society.

THE seventy-fourth Annual Exhibition of the Royal Photographic Society is now open and may be seen until Oct. 12 at the Society's rooms at 35 Russell Square. The greater part of the work shown is pictorial. It would, however, be presumption on the part of the present writer to discuss the merits of artistic photography, and readers of NATURE may be supposed to take a deeper interest in the scientific and technical section of the Exhibition; it will therefore be sufficient here to direct attention to some of the more outstanding exhibits in the latter section.

To say that photography is a method of recording by means of light may be to utter a platitude, yet this exhibition pays a striking tribute to the amazing diversity of the applications of photographic recording in scientific and other work.

Archæology is well represented. The University of Chicago Epigraphic Exhibition from Luxor shows a fine photograph of a part of the wall of the Temple of Medmet, together with the result obtained by inking and bleaching such a print. The scene depicted is that of Rameses III. advancing in battle against hostile Libyans. No less interesting is a group of four church roof bosses photographed by Capt. Cave, who has developed a special technique for dealing with these dimly lighted, inaccessible subjects. These are, of course, special applications of ordinary still photography, and there are many examples of the same kind—map-making and aerial photography, cloud photography, police records, and so on through a very wide field. Photographic methods may also be used to record the appearance of bodies in rapid motion, and we have long been familiar with photographs of athletes in the very act of moving, and such like subjects. J. A. Speed has devised a method for extending this kind of work to the photography of animals. By synchronising the firing of specially prepared magnesium flashlight powder with the working of the camera shutter, he has been able to obtain excellent photographs of some of the shyest animals. His pictures of a honey bee in flight, a swallow in flight, and a leaping stoat are indeed excellent.

Capt. Quayle shows some very fine photographs of objects moving even more rapidly—bullets in flight. Three 'stories' are illustrated. In one we are shown successive photographs of a charge of shot impinging upon a clay pigeon. In another series a hollow-pointed bullet is shown at various stages of penetration through a slab of paraffin. In the third is shown a bullet fired from a worn and rusty rifle. Friction in the barrel of the rifle has punctured the metal casing of the bullet and melted the lead inside. The spinning bullet goes forward throwing out a spray of molten lead through the hole in its side, much in the manner of a catherine wheel moving perpendicularly to the plane of its rotation.

A. G. D. West and the Research Department of the Gramophone Company show photographic records of sound waves. Such records are now used very extensively in the study of the acoustic properties of buildings. One of these studies concerning the echoes in the Albert Hall is illustrated.

Some phases in the manufacture of photographic materials are illustrated by two exhibits sent in by British firms. Messrs. Ilford, Ltd., show some of the materials which are used in producing a photographic film; samples of a photographic emulsion at various stages of manufacture are also shown. Messrs. Illingworth and Co., Ltd., show a working model of a machine for coating paper with a sensitive emulsion. The way in which hundreds of feet of paper are automatically coated, set, looped, dried, and rolled up in a continuous process seems beautifully simple when we see this model in action.

There are many excellent samples of photomicrography. Dr. L. C. Martin and F. Lucas both show photomicrographs of biological subjects taken with ultra-violet light. It is stated that by this method magnifications so high as 5000 diameters result in crisp brilliant images with a degree of resolution surpassing by far that achieved with any other known optical system.

One more exhibit may be mentioned. The Mount Wilson Observatory sends a photographic map of the infra-red solar spectrum. By means of neocyanine, plates have been made sufficiently sensitive to record lines of wave-lengths down to about 11,400 A.

S. O. R.

University and Educational Intelligence.

THE list of University Extension Lectures and University Tutorial Classes issued by the University of London is of interest mainly to students of literary subjects. Science, however, is not unrepresented: courses are to be given by Mr. J. C. Hill on psychology and by Dr. W. J. Perry on the history of religions, at Morley College; by Mr. F. Addey on general astronomy, at the Royal Crystal Palace Hotel, Upper Norwood; by Mr. G. C. Robson on progress and decline in animate Nature, at West Ham Municipal College; by Dr. A. Wilmore and Mr. A. N. Wilmore on various aspects of

geography, at Westminster Training College. Particulars of courses can be obtained from the University Extension Registrar, University of London, South Kensington, S.W.7.

WE have received from the United States Bureau of Education a copy of its Biennial Survey of Education, 1924–26 (Washington, D.C.: Government Printing Office. 2.30 dollars). Half of the volume is a convenient compilation of studies, most of which have already appeared in the course of the past two years in the form of 'advance sheets', by members of the Bureau's departmental staff and other specialists, and the rest consists of statistical tables (general statistics, State school systems, city school systems, universities, colleges, and professional schools, teachers' colleges, public high schools, private high schools, and private commercial and business schools), representing the most important class of the Bureau's publications of 1927–28. Among the subjects of the special studies are: Trends in the development of secondary education, industrial education, commercial education, home economics, adult education, educational surveys, parent-teacher associations, educational boards and foundations, and education in foreign countries. Of special interest as evidence of enthusiasm for education and self-examination are the chapters on parent-teacher associations and educational surveys. The former shows a growth in membership of parent-teachers associations from a hundred thousand to a million in six years, and the latter gives particulars of a great variety of investigations, each having for its purpose the unbiased analysis of educational situations which may be used as bases for formulating programmes for improvement.

UNIVERSITY matriculation requirements in the United States formed the subject of an investigation recently conducted by the professors of education at Leland Stanford Junior University and the State Teachers' College of Kansas. The field of inquiry included 331 colleges and universities and 977 high schools. The results of the investigation are reported in the April number of *School Life*. It was found that English was the only subject recognised by all as indispensable for candidates for admission to university courses. Some degree of proficiency in mathematics is required by 96 per cent of the institutions reporting, in social science by 77 per cent, in a foreign language by 75 per cent, and in laboratory science by 54 per cent. Of the women's colleges only 25 per cent require science, whilst 74 per cent require Latin. Among the conclusions resulting from the investigation are: there is a wide demand for the restatement of admission requirements in terms allowing more latitude as regards subjects offered, and ousting mathematics and foreign languages, in particular, from their privileged position; an increasing minority of those concerned view with favour the relatively new ideas of grading candidates with reference to results of intelligence tests and reports on such personality traits as industry, reliability, judgment, cooperativeness, leadership, initiative, and physical vitality as well as average scholarship; much progress has been made towards harmonising the views of the high school principal and the university, through the appreciation by the latter of the necessity confronting the high school of meeting the needs of all its pupils and conforming its programme of studies to those needs. The articulation of university and secondary education will be further improved as a result of the general survey of secondary education recently authorised by Congress to be carried out in the course of the next three years.

Calendar of Patent Records.

September 28, 1799.—One of the pioneers of gas lighting was Philippe Lebon, to whom a French patent for "Nouveaux moyens d'employer les combustibles plus utilement, soit pour la chaleur, soit pour la lumière, et d'en recueillir les divers produits", was granted on Sept 28, 1799. No practical use appears to have been made of Lebon's apparatus for lighting purposes, but he established a tar factory near Le Havre which obtained some success.

September 29, 1842.—W. S. Henson was the first to design a heavier than air flying machine on the lines of the modern monoplane, a patent for his machine, driven by a steam-engine, being granted to him on Sept. 29, 1842. The aeroplane, known as the 'Aerial steam carriage', was well advertised in the Press of the period but was never actually constructed. Henson was assisted in his experiments by Stringfellow, who constructed a steam-driven model aeroplane—now in the Science Museum—which was the first machine to fly under its own power.

October 1, 1852.—Up to 1852, the procedure for obtaining a patent for an invention in England was the same as that prescribed for any other grant under the Great Seal, and involved, after the Petition had been lodged, separate visits, with the appropriate fees in each case, to the Secretary of State's office, the Attorney or Solicitor-General, the Signet Office, the Privy Seal Office, and the Chancery Patent Office, and the subsequent enrolment of the grant and of the specification. By the Patent Law Amendment Act which came into force on Oct. 1, 1852, one office was provided for all stages of the grant, a single patent was obtainable for the whole of the United Kingdom, and all specifications were printed and made readily available to the public.

October 2, 1608.—Though he cannot be called the first inventor of the telescope—for these were known previously though more or less only as scientific curiosities—Johann Lipperhey, spectacle maker of Middelburg in Holland, who on or before Oct. 2, 1608, applied to the States-General for a privilege for thirty years, or alternatively for the grant of a pension in respect of the invention, must be given the credit of being the first to make telescopes commercially, and from him dates the realisation of their importance and their practical application. Fifteen days after Lipperhey's petition and while this was still pending, a similar application was received from Jacob Adriaanzoon, and finally Lipperhey's application was refused on the ground that "many other persons had a knowledge of the new invention". Three instruments — binoculars — were, however, ordered from him, and he received 900 florins in payment.

October 2, 1839.—The earliest proposal to apply electricity to clocks and to provide a system of synchronised secondary clocks controlled by a standard clock was made by Karl August von Steinheil, who was granted a Bavarian patent for three years for the invention on Oct. 2, 1839, thus preceding by some months Alexander Bain and Sir Charles Wheatstone in England. A description of Steinheil's invention was published in the Munich journal *Kunst- und Gewerbeblatt* for 1843.

October 3, 1687.—On Oct. 3, 1687, a patent was granted to Joseph Mason for "an engine by the help of which a weaver may performe the whole worke of weaving such stuffe as the greatest weaving trade in Norwich doth now depend upon, without the help of a draught-boy". No description of the invention is available, but the services of the draw-boy were not finally dispensed with in figure weaving until the invention of the Jacquard machine in 1790.

Societies and Academies.

PARIS.

Academy of Sciences, Aug. 26.—F. E. Fournier: Observations of the tour of the world by the *Graf Zeppelin*.—André Blondel: The calculation of the falls of potential of transformers of potential of alternating currents, when they require a strong exciting current.—William Bowie: Concerning vertical prisms of the earth possessing the same mass.—Georges Giraud: Certain problems analogous to the problem of heat.—Bernard Salomon: The gyroscopic analogies of mutual induction and of magnetic losses.—Maurice Roy: Propellers with limited vein and Froude's ideal propeller.—Vasilesco Karpen: Can the Maxwell-Clausius relation be demonstrated without recourse to Carnot's principle? Reply to criticisms by Verschaffelt.—Eduardo Mª Galvez: The fall of potential in electrical generators.—J. Dourgnon and P. Waguet: Calculation of the illumination produced by non-point sources, radiating according to Lambert's law and of constant brightness.—Jean Lugeon: The genesis of heat storms and their prediction with the aid of [wireless] atmospherics. From a curve showing the number of atmospherics per minute, the particular kind of heat storm common in Switzerland can be predicted one or two hours in advance.—Carl Störmer: Retarded echoes [in wireless telephony]. In an earlier communication the author attributes the echo to reflection at surfaces of electrified particles in space outside the moon's orbit. The hypothesis of the existence of such surfaces was first put forward to explain observed phenomena in connexion with aurora borealis. Further cases of wireless echoes described by various observers are cited, and a connexion is shown between the angle ψ (angle between the direction earth–sun and the equatorial magnetic plane) and the echoes. With one exception all the echoes were noted when the angle ψ was small, $+4{\cdot}3°$ to $-9{\cdot}0°$, but negative results were obtained when ψ was large ($-31°$ to $33°$). Suggestions are put forward for further international observations.—A. Guichard: The ontogeny of the vegetative leaf of *Carex glauca*.—A. Hée: The influence of cold waves on the respiration of plants. For old leaves, exposure to cold is followed by a marked increase of the respiratory intensity. For young leaves, a slight fall of temperature below 0° C. causes a diminution of the value of respiration. The modifications in the respiratory intensity produced by low temperatures are temporary, the respiration becoming normal when the temperature is maintained above 0° C.—R. Bonnet: The evolution of nitrogen during germination.—J. Lemarchands: Researches on the transformations, and more especially on the saponification of the reserve fats in seeds during germination. The first change in the fatty reserves is a saponification and there is no preliminary oxidation of the glycerides: the oxidation of the free fatty acids starts with the unsaturated acids.—Jean Roche: Some physico-chemical properties of natural globin.

Sept. 3.—H. Vincent: The pathogenic effects exercised on man and animals by the neurotrope exotoxin of *Bacillus coli*: description of symptoms of various types of intoxication by this toxin, some of which could only be identified as due to this poison by the fact that anticolibacillus serum led to an immediate cure.—Eugène Flutsky: Some propositions on stochastic limits.—G. Vranceanu: Riemann spaces having their coefficients of rotation constant.—Hasso Harlen: Some properties of ensembles.—N. Lusin: A general principle of the theory of analytical ensembles.—A. Kovanko: A class of nearly periodic functions which give rise to the classes of *p.p.* functions of W. Stepanoff, H. Weyl, and Bezicovitch.—R. Jungen: Remarks on a theorem of M. Hadamard relating to the multiplication of singularities.—L. Rosenhead: The alternating vortices of Bénard-Kármán in a canal of finite width.—Henri Villat: Observations on the preceding note.—P. Delanoë: The Moroccan spirochætes of the Ornithodores from burrows and the spirochæte of Mansouria are not recurrent in man. They constitute a distinct species of the Spanish spirochæte, *Sp. hispanicum*. In Morocco there are at least three spirochætes pathogenic for man, *Sp. recurrentis*, *Sp. hispanicum*, and a non-recurrent spirochæte, *Sp. marocanum*.

BRUSSELS.

Royal Academy of Belgium, Dec. 1.—Th. De Donder: The rôle of affinity in undulatory mechanics.—Constant Lurquin: A limit theorem for probability in the sense of Bienaymé-Tchebycheff.

Dec. 13.—J. E. Vershaffelt: The practical determination of surface tension by the method of separation of discs. A simplification of the method of calculating the surface tension from the experimental results based on the use of successive approximations.—Boutaric and Mlle. G. Perreau: Study of the *p*H coefficients producing flocculation of an arsenic sulphide sol and a ferric hydrate sol.

Dec. 14.—Victor Willem: The architecture of bees.—Armand Renier: Belgium in the Carboniferous period.

Jan. 5.—Th. De Donder: The invariantive theory of the calculus of variations.—L. Godeaux: Certain cyclic involutions belonging to algebraic curves.—Lucien Godeaux: The envelope of the Lie quadrics of a surface.—Jean Baudrenghien: The preparation and properties of the 1 : 2 dimethyl-cyclopropanes. These hydrocarbons have been prepared by five different methods, which are described in detail.—E. Henriot: The dynamic magnitudes transported by light.

Feb. 2.—Th. De Donder: (1) Invariantive theory of the calculus of variations. (2) The principle of correspondence of the generalised Dirac undulatory mechanics.—M. Dehalu and P. Swings: Observations of Jupiter made at the Cointe Observatory.—L. Godeaux: The Wilczynski directrices and Lie quadrics of a surface.—E. Henriot: The possibility of representing the movements of energy by means of two waves of velocity *c*.

Mar. 2.—Edm. van Aubel: Magnetostriction in bismuth. Claim for priority.—Th. De Donder: Invariantive theory of the calculus of variations.—P. Martens: Experimental study of the sporocyte chromosomes in *Tradescantia*.—Mlle. L. de Brouckère: The adsorption of electrolytes by crystalline surfaces. Studies in the adsorption of the chlorides of cadmium, mercury, lanthanum, and lead by barium sulphate.—Y. Glivenko: Some points in the logic of Brouwer.—R. H. J. Germay: An extension of the Lagrange formula and its application to the solution of the equation of Gauss.

Official Publications Received.

BRITISH.

The Agricultural Department, Madras. Bulletin No. 94: Field Experiments with Calcium Cyanamide as a Nitrogenous Manure for South Indian Soils and Crops. By B. Viswanath and S. Kasinathan. Pp. 17. 4 annas. Bulletin No. 95: The Work of the Livestock Section. By R. W. Littlewood. Pp. 9+6 plates. 6 annas. Bulletin No. 96: Cultivation of Grape Vines. Pp. 6. 2 annas. Year Book, 1928. Pp. ii+66+8 plates. 14 annas. (Madras: Government Press.)

Mines Department. Seventh Annual Report of the Safety in Mines Research Board; including a Report of Matters dealt with by the Health Advisory Committee 1928. Pp. 88+2 plates. (London: H.M. Stationery Office.) 1s. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1230 (Ae. 385): Pressure Plotting a Streamline Body with Tractor Airscrew Running. By C. N. H. Lock and F. C. Johnson. (T. 2721.) Pp. 22+8 plates. 1s. net. No. 1234 (Ae. 389): Tests on Airship Models at Large Reynolds Numbers. By L. F. G. Simmons. (T. 2724.) Pp. 7+2 plates. 6d. net. (London: H.M. Stationery Office.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 26: The Uranyl Oxalate Method of Daylight Photometry and its Photo-Electric Standardization. By Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 321-339. 1s. 6d. Vol. 19 (N.S.), No. 28: The Photo-Chemical and Photo-Electric Measurement of the Radiation from a Mercury Vapour Lamp. By Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 355-364. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1228 (Ae. 383): Full Scale Control Tests on Fokker F. VII 3M Monoplane. By J. K. Hardy. (T. 2715.) Pp. 8+7 plates. (London: H.M. Stationery Office.) 9d. net.

Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1927-28. Pp. 91. (London: H.M. Stationery Office.) 3s. net.

Department of the Interior: North West Territories and Yukon Branch. Yukon: Land of the Klondike. By F. H. Kitto. Pp. 45. (Ottawa: F. A. Acland; London: High Commissioner of Canada.)

Bulletin of the British Cast Iron Research Association. No. 25, July. Pp. 141-184. (Birmingham.)

Battersea Polytechnic, Battersea Park Road, S.W.11. Technical College for Day Students, and Day School of Art and Crafts: Calendar, Session 1929-1930. Pp. 47+12 plates. 3d. Domestic Science Department and Training College: Full Time Day Instruction, Afternoon and Evening Classes, Session 1929-1930. Pp. 34+7 plates. 3d. Department of Hygiene and Public Health, Session 1929-30. Pp. 25+3 plates. 3d. Calendar of Evening and Afternoon Courses and Classes for the Session 1929-1930. Pp. 31+9 plates. Free. (London.)

The Proceedings of the Physical Society. Vol. 41, Part 5, No. 230, August 15. Pp. viii+431-605+ix-xxiv. (London.) 7s. net.

Journal of the Indian Institute of Science. Vol. 12A, Part 7: i. Formation of Heterocyclic Compounds from Diethylxanthic Formic Ester, by Praphulla Chandra Guha and Devendra Nath Datta; ii. Ring Closure of Hydrazo-Monothiodicarbonamides with Acetic Anhydride; Formation of Iminothiobiazolones and Iminothioltriazoles, by Praphulla Chandra Guha and Tarani Kanta Chakraborty. Pp. 79-104. (Bangalore.) 1.4 rupees.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Professional Paper 144: The Copper Deposits of Michigan. By B. S. Butler and W. S. Burbank. Pp. xii+238+75 plates. 2.50 dollars. Professional Paper 154-B: The Fauna of the Middle Boone, near Batesville, Arkansas. By George H. Girty. (Shorter Contributions to General Geology, 1928.) Pp. ii+73-103+plates 9-12. 15 cents. Professional Paper 154-C: Salinity of the Water of Chesapeake Bay. By R. C. Wells, R. K. Bailey and E. P. Henderson. (Shorter Contributions to General Geology, 1928.) Pp. ii+105-152+plate 13. 15 cents. Professional Paper 154-D: Origin of the Siliceous Mowy Shale of the Black Hills Region. By William R. Ruby. (Shorter Contributions to General Geology, 1928.) Pp. ii+153-170+plates 14-16. 10 cents. Professional Paper 154-E: Oil Shale in a Producing Oil Field in California. By H. W. Hoots. (Shorter Contributions to General Geology, 1928.) Pp. ii+171-173+plate 17. (Washington, D.C.: Government Printing Office.)

Californian Agricultural Extension Service. Circular 29: Control of Pocket Gophers and Moles in California. By Joseph Dixon. Pp. 16. (Berkeley, Calif.)

University of California Publications in Zoology. Vol. 30, No. 14: Mammals collected by Charles D. Brower at Point Barrow, Alaska. By E. Raymond Hall. Pp. 419-425. Vol. 30, No. 15: Pterylography of certain North American Woodpeckers. By William Henry Burt. Pp. 427-442. Vol. 32, No. 2: The Avifauna of Emeryville Shellmound. By Hildegarde Howarde. Pp. 301-394. (Berkeley, Calif.)

Transactions of the San Diego Society of Natural History. Vol. 5, No. 16: Notes on the Marine Pleistocene Deposits of San Diego County, California. By Frank Stephens. Pp. 245-256. Vol. 5, No. 17: A new Miocene Echinoid from California. By Hubert Lyman Clark. Pp. 257-262+plate 21. Vol. 5, No. 18: Loliolopsis Chiroctes, a new Genus and Species of Squid from the Gulf of California. By S. Stillman Berry. Pp. 263-282+plates 32-33. (San Diego, Calif.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 8: Het Klimaat van Nederlandsch-Indië. Door Dr. C. Braak. Deel 11, Aflevering 3: Buitengewesten behalve Sumatra. (With English Summaries.) Pp. vii + 401-545 + 187-257 + 2 plates. (Weltevreden.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 193: On the Transition Probability between two States with Positive or Negative Energy in a Central Field due to Nuclear Charge *Ze*. By Y. Sugiura. Pp. 80. 1.00 yen. No. 197: On the Tautomerism of 2:5-Dithiopiperazine. By S. Ishikawa. Pp. 119-129. 25 sen. No. 198: The Near Infra-red Spectra of Helium and Mercury. By T. Takamine and T. Suga. Pp. 131-137. 20 sen. No. 199: A Study of the Helium Band Spectrum, III. By S. Imanishi. Pp. 139-149. 25 sen. (Tokyo: Iwanami Shoten.)

CATALOGUES.

Foster Optical and Radiation Pyrometers. (Book No. 45.) Pp. 44. (Letchworth: Foster Instrument Co.)

The Taylor-Hobson Outlook. Vol. 3, No. 14, September. Pp. 129-136. (Leicester and London: Taylor, Taylor and Hobson, Ltd.)

Wild-Barfield Electric Furnaces for all Industrial Purposes. Pp. 10. (London: Wild-Barfield Electric Furnaces, Ltd.)

The Nickel Bulletin. Vol. 2, No. 3, September. Pp. 65-96. (London: The Mond Nickel Co., Ltd.)

Laboratory Fittings, including "Technico" Standard Unit Type Benches. (List F, revised August.) Pp. 40. (London: A. Gallenkamp and Co., Ltd.)

Diary of Societies.

FRIDAY, SEPTEMBER 27.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (in County Hall, March), at 11.30 A.M.—Capt. G. E. Mathews: The Drainage of the Fens.

INSTITUTE OF MARINE ENGINEERS (at Olympia), at 6.30.—H. Barringer: Modern Tanker Practice (Lecture).

INSTITUTE OF BRITISH FOUNDRYMEN (Sheffield and District Section) (at King's Head Hotel, Sheffield), at 7.30.—G. L. Oxley: Presidential Address.

SATURDAY, SEPTEMBER 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall, Wisbech), at 10.30 A.M.—S. Matthew: Notes on the Borough of Wisbech.—R. S. W. Perkins: Notes on the Work of the Highways Department of the Isle of Ely, C.C.

TUESDAY, OCTOBER 1.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Miss A. Hibbert-Ware: Field Notes on New Zealand Birds.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8.—Prof. W. Morgan: The Member and the Institution (Presidential Address).

TELEVISION SOCIETY (at Engineers' Club, Coventry Street), at 8.—H. S. Ryland: Talking-Films.

SOCIETY OF CHEMICAL INDUSTRY (London Section).—H. A. Sloman: A New Method for the Production of Pure Beryllium Oxide from Beryllium Ores.—R. Taylor: Isolation of Helium from Monazite Sand.

WEDNESDAY, OCTOBER 2.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. H. E. Cox: Chemical Tests in Relation to Fur Dermatitis.—J. H. Coste: Demonstration of a Nomogram for Use in Gas Analysis.—P. S. Arup: The Composition of Irish Winter Butter.—Dr. W. R. Schoeller and H. W. Webb: Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. XVI. Observations on Tartaric Hydrolysis. XVII. The Quantitative Precipitation of the Earth Acids and certain other Oxides from Tartrate Solution.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, OCTOBER 3.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—W. J. Hadfield: Some Road Questions.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section), at 7.30.—Dr. H. Levinstein: Presidential Address.

FRIDAY, OCTOBER 4.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. J. Hill: Engineering Experiences on a Tea Estate in Assam.

SATURDAY, OCTOBER 5.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—Dr. P. B. Ballard: A Talk about Modern Methods.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—E. A. Martin: Gilbert White and his Village.

ANNUAL MEETING.

MONDAY, SEPTEMBER 30, TO SATURDAY, OCTOBER 5.

BRITISH MYCOLOGICAL SOCIETY (at Bristol).

Monday, Sept. 30, at 8.—Reception by Prof. and Mrs. Darbishire.

Tuesday, Oct. 1, at 10 A.M.—Foray.
At 8.45.—Annual General Meeting.

Wednesday, Oct. 2.—Visit to Long Ashton Research Station.
At 8.45.—Miss E. M. Wakefield: Fungi Exotici: Past Work and Present Problems (Presidential Address).

Thursday, Oct. 3, at 11 A.M.—Foray.
At 8.—J. Ramsbottom: The Influence of Fungi on Life in General (Popular Open Lecture).

Friday, Oct. 4, at 11.30 A.M.—Foray.
At 8.45.—Carleton Rea: Comments on the Finds of the Week.

CONFERENCE.

OCTOBER 10 TO 12.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF TUBERCULOSIS (at Connaught Hall, Newcastle-upon-Tyne).

Thursday, Oct. 10.—Dr. H. Mess: Tuberculosis on Tyneside: a Sociological Study.
Dr. E. Rist and others: The Factors that produce Pulmonary Tuberculosis.

Friday, Oct. 11.—Dr. W. Brand: A Scheme of National Propaganda regarding Tuberculosis.
Dr. A. H. Macpherson: Combined Treatment and Technical Education of Tuberculous Youths.
Dr. T. Beattie and Dr. F. Hewat: The Teaching of Tuberculosis to Undergraduates.
Dr. W. H. Dickinson: The Training of Tuberculosis Medical Officers.
Dr. H. Williams: Methods of Medical Propaganda regarding Tuberculosis.
Dr. W. Guy: Dentistry in Relation to Tuberculosis.