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Recruitment in the Colonial Services.

A SHORT time ago a Committee was appointed, under the chairmanship of Sir Warren Fisher, to report on the "System of Appointment in the Colonial Office and the Colonial Services"; its report, which has been recently issued, merits careful consideration. In an opening section attention is directed to the extraordinary diversity of the territories administered by the Colonial Office, covering an area of two million square miles, practically all within the tropics, with a population of nearly fifty millions. Although often alluded to as the 'Colonial Service', in effect there is no such thing, as the Colonial Secretary has to deal with the affairs of more than fifty distinct governments, ruling territories in size from as large as Central Europe down to remote island groups; conditions of life, material equipment, and economic factors being entirely dissimilar.

Recruitment to fill the government posts in these diverse governments has developed in the past in a haphazard fashion under varying conditions, depending more on the ideas of a local governor for the time being than upon those of the authorities in Great Britain. Since the Armistice, matters have greatly improved and the number of posts has increased. In 1909 the appointments made by the Colonial Office numbered 657; in 1929 they rose to 1076, and this in spite of the fact that many classes of appointments, which were normally filled from Great Britain twenty years ago, are now staffed locally. But the Committee insists on the fact that this is not merely a matter of numbers. "Modern conditions demand also a generally higher standard of personal, educational, and professional qualifications, and in addition the employment of men with scientific and special attainments of a kind not previously to be found in the Colonial Service." It is the Committee's recommendations on this latter part of the problem which it is proposed to consider here.

It will be necessary, however, to summarise briefly the excellent exposition given in the Report of the present system of appointment to the various Colonial Services (it is not proposed to dwell on the internal administration of the Office at home), and the recommendations made for its improvement. Apart from local recruitment, the selection of home candidates for employment in the Colonial Services is made in four chief ways: (*a*) The Civil Service Commissioners in London hold periodical examinations for the selection of candidates for Eastern Cadetships (administrative appointments in Ceylon,

Malaya, Hong-Kong, etc.), for the Ceylon police and for the post and telegraph services in Nigeria and the Gold Coast; (*b*) the Crown Agents to the Colonies select and appoint on behalf of Government candidates for technical posts, such as railways, public works, and so on, the selected men serving for a term of years; (*c*) the Private Secretary (Appointments) to the Secretary of State, aided by a strong staff, selects and recommends to the Secretary of State outside candidates for a first appointment in the Services; (*d*) other departments of the Home Government are asked, where necessary, to select from their staffs men with the desired qualifications to fill certain appointments overseas. These departments are the War Office, Post Office, Customs and Education, Home Office and Air Ministry.

It will be evident from the above résumé how varied have been the methods which have grown up with the object of securing quantity, quality, and variety of the staff required to carry on the great area administered from the Colonial Office.

We are here concerned with the great variety of appointments, by far the larger number annually, the selection for which is carried out, and, as the Committee emphatically emphasises, admirably carried out, by the Private Secretary (Appointments) and his staff. The Private Secretary and staff have always been able to obtain the advice and assistance of specialist advisers, both from the Colonial Office and the universities and from men of eminence in various professions, and lastly from senior Colonial officials on leave or recently retired. The Committee places on record that the selection of candidates has at all times been undertaken with the greatest care and that the Colonial Governors have expressed entire approval of the type sent out. The Committee is also at pains to show that the idea, which has prevailed in some quarters, that Oxford and Cambridge have been specially favoured in this selection is not borne out by facts. The bulk of the appointments in administration have gone, for various demonstrable reasons, to these two universities; but London and the Scottish universities have provided the largest number of men for appointments in medicine and scientific departments, Edinburgh being specially mentioned as "the principal source" for forestry.

Whilst fully acknowledging the successful manner in which the selection of candidates is carried out, the Committee considers it undesirable that it should continue to be performed by a staff of private secretaries to the Secretary of State. It recommends that this staff should cease to be in the position of private secretaries and that the appointments branch should be incorporated as a permanent part of the Personnel Division of the Colonial Office. In addition, it is recommended that a Colonial Service Appointment Branch, consisting of a chairman and two members nominated by the Civil Service Commissioners, should be set up as a standing independent branch for the final selection of candidates whose names are put forward by the appointments branch, and that the names of those selected be then submitted to the Secretary of State, on whose authority the appointments will be made. It is also suggested that the promotions branch should be reorganised on a smaller scale and be a section of the Personnel Division. There can be little doubt that these are excellent suggestions, and if put into effect they will greatly strengthen the hands both of selectors for first appointments and also of those dealing with that important question of promotion. On the able recommendations of the Committee on the latter question space will not permit further digression; but in the future interest of the Service they merit careful consideration.

One other recommendation of the Committee requires mention before the scientific services are considered. The question of the unification of the Colonial Service is discussed. The Committee points to the hardships of officers on small cadres in the smaller dependencies, and admits all the objections which have been put forward—differences of salary, leave, pension, climate, customs and language of the people, and so forth; it recognises the reluctance of Governors and others to any change. After a consideration of all the objections, the Committee remains convinced of the importance of unification and recommends that a single Colonial Service should be formed and that, within this larger whole, unified special services should be organised, such as agriculture, forests, medicine, education, and so forth. As the Committee correctly points out, this issue is of the very first importance: "Much of the information on which it rests cannot be present in the minds of Governors or their advisers overseas, since it relates particularly to questions of home recruitment and to the difficulties of individual Colonies".

The question of the technical and specialist research officers remains to be considered. The Committee states that

"many of the officers appointed to scientific and technical services such as agriculture, forestry, veterinary, medical, and so forth, are qualified to undertake research work of a fundamental character, and some officers are appointed in the first instance

for the specific purpose of carrying out research work on urgent problems confronting a particular service. In the ordinary course, however, an officer appointed to the agricultural service with special knowledge of plant diseases or insect pests, would rank for promotion in the higher grades in that service along with officers engaged in more general and less systematised duties, and would not necessarily confine himself to work of a specialised character throughout his service."

The statement that "many" of the officers appointed to the above services "are qualified to undertake research work of a fundamental character" would, for some of the services, scarcely be admitted at the universities. Twenty per cent would probably be too high a percentage. Experience has also shown that a young officer, on first appointment, should have a few years of executive work *before* being detailed for research. This will prevent his making recommendations, when he takes up research, which the executive officer knows to be impracticable. But this type of research officer, as the Committee points out, belongs to a definite service, will go up the grades of that service, will not necessarily confine himself to research all his service, and has a chance of securing the prizes of his own service. His social position is also assured as a member of a service.

The other type of research officer is perhaps of even greater importance—the whole-time specialist. As the Committee must have realised, this type has so far received scant attention. His value is not called in question. He is in demand. The universities could say in how great demand. They are aware that Government has now to compete in this market in some directions with the wide-awake commercial people. These specialist research officers are selected on the understanding that their whole service will be devoted to their particular line of research. It is contemplated that their work will be of such a character that any results they may obtain will be applicable in many parts of the Colonial Empire. Some of them may find it practicable to pursue their investigations in one particular research institution. Others may find it necessary to conduct their researches in different parts of the Empire, attached either to a research station or to a scientific department. In the normal course of things it is neither to be expected nor would it be desirable that their advancement should be conditioned by the occurrence of vacancies in the higher ranks of services other than their own. The Committee states that "it does not follow that such a service should be graded like other colonial services, for each individual in it must determine his own line of research in his particular sphere of work". In this connexion the Committee says:

"In our opinion Research Officers should be encouraged by means of special inducements in the way of salaries and other terms of service to continue their long-range investigations. These terms should, in our opinion, be at least equal to those which they would be likely to obtain if they were prepared to abandon purely research work for more general duties."

Clearly there are considerations other than salaries to be taken into account in dealing with the research officers, and we should have preferred the Committee to have been more specific in its references to this class. It would be disastrous for recruitment if the research officer were to remain 'no man's child', which would mean that he would not enjoy the social position which attaches to the services in the Empire-circles overseas (and is of importance out there). The man may not care about this, but when he marries his wife will, and Government will lose a good man. An example may be quoted. Soon after the formation of the Agricultural and Forestry Research Institutes at Pusa and Dehra Dun, India, by Lord Curzon, a representative from each centre met by chance and discussed prospects. In reply to some remark, the Pusa man ejaculated, "Yes, your position is very different. You belong to a Service. We at Pusa do not." Dehra Dun was staffed from the Indian Forest Service. The Pusa specialist returned home shortly afterwards and was a great loss. That conversation took place more than twenty years ago!

A possible way out of this difficulty, it may be suggested, would appear to be to appoint each specialist research officer (for example, of the type serving in Malaya and Tanganyika) to one or other of the scientific or technical services (to which his investigations most nearly correlate) and then second him for research work, on the understanding that his service would be spent on such work: much as Royal Engineer and Military Medical officers are seconded for civil duty and remain seconded for the rest of their service. High salaries, higher than the Colonial Office could afford to offer, will not tempt, or if tempted retain, the right stamp of man unless the social conditions of life are assimilated to those of the Services. Incorporated in a Service, seconded with staff pay as specialised research officers, would, it is believed, remove the existing disabilities and secure in increasing numbers the type desired for this increasingly important work. The Committee thus alludes to this work:

"On the economic side we have to bring to bear the latest results of scientific research on the development of wealth, which is important, not only to the Colonies themselves but also to the Empire and the World. Most of the greater problems of the Colonies to-day are problems of Applied Science."

Possibly, however, the Committee wishes the research service to be a separate entity, under the general administrative control and supervision and responsible alone to an officer at the Colonial Office, linked through him with the various Imperial Bureaux which have recently been established, and through them with the British Dominions. This is the underlying assumption in the various reports on colonial research to which the Committee refers, and particularly that of the sub-committee which reported to the Colonial Office Conference of 1927 on the possibilities of the creation of a Colonial Scientific and Research Service, available for the requirements of the whole Colonial Empire; in other words, the creation of an Imperial Service, financed out of an Imperial fund, to replace a number of water-tight provincial services which have too long been dependent on individual Colonial governments, most of which have hitherto given little indication of their appreciation of the value of long-range research.

How Fire Became Known.

Myths of the Origin of Fire: an Essay. By Sir James George Frazer. Pp. vii + 238. (London: Macmillan and Co., Ltd., 1930.) 12*s.* 6*d.* net.

A NEW book by Sir James Frazer is assured of a cordial welcome, both on account of the exhaustive compilation of material which is rendered easily accessible to readers, and by reason of the charming literary style in which the collected data are placed on record and discussed. The problems which are suggested by the mass of facts brought together and collated are without question intriguing. In the present instance Sir James has set himself the task of collecting together for comparative study the various myths and legends which serve to explain to the primitive mind the way in which fire became known to mortals, and how, later, a knowledge was acquired of the means of producing fire at will. Man, without doubt, was acquainted with and made use of fire, as kindled by natural processes, long prior to his discovery of the fact that it was possible to *make* fire by artificial means whenever occasion demanded. Sir James even suggests a phase when man was "ignorant of the use or even of the existence of fire", and discusses the problem in terms of three successive phases, (1) the Fireless Age, (2) the Age of Fire Used, (3) the Age of Fire Kindled—phases which appear to be suggested by a study of the beliefs in regard to the origin of fire. While the latter two phases are readily acceptable, as coming within the period of early human culture-development, it is less easy to imagine even the most primitive members of the genus *Homo* having been entirely unacquainted with fire as a phenomenon in Nature. There is no evidence to prove that Nature did not cultivate the incendiary habit until man was already specialised as Man and had become differentiated from the rest of the animal kingdom. His forerunners must already have experienced Nature-kindled fire and must have learned to respect, or at any rate fear it. It seems very unlikely that even proto-man could have completely lacked such experiences, and it becomes difficult to credit a human phase involving complete ignorance of fire.

In nearly all the myths of the origin of fire as an accessory to human culture, the supernatural plays an important part, and the pre-scientific attempts of primitive minds to interpret the phenomenon of fire naturally do not show any inkling of its true nature. In a strikingly large number of the legends, fire is reputed to have been stolen for man's use, usually from some supernal possessor; and, similarly, knowledge of the art of *making* fire has been very widely believed to have been obtained by trickery. So wide-spread among primitive peoples is this belief in the original theft of fire, that it appears highly probable that the Promethean myth of the ancient Greeks, with its closely similar record of the purloining of fire from Zeus, or from Hephæstus, was inherited as a traditional story handed down from a remote past, undergoing variation in detail to adapt it to local environmental and culture conditions. It appears far more probable that this fire-legend of Prometheus was a slightly modified descendant from an ancient and widely diffused folk-tale, than that in it we see the prototype of a myth which spread from a centre of advanced culture and became disseminated among a vast number of heterogeneous and widely separated peoples of low culture.

Prometheus, according to the legend, carried the fire which he had stolen ἐν κοίλῳ νάρθηκι, and, as Sir James says (p. 195), the *narthex* "is commonly identified with the giant fennel. . . ." He expresses doubt as to Theodore Bent's suggestion that the *narthex* was a reed inside which the smouldering tinder was carried "to prevent its being blown out" ("Cyclades", p. 365). The reason given for this

practice is questionable, since smouldering pith and other tinder substances burn more freely when blown upon, and it is probable that the protection would be against too rapid consumption of the tinder rather than against extinction of the spark. But there is some support for the theory that the *narthex* was a reed tube used to contain the tinder, since at the present day the custom obtains, in Manchuria, for example, of igniting a piece of pith and of carrying it smouldering in a tube of reed or bamboo. This at least gives some plausibility to the suggestion that the legendary Greek fire-thief carried his ignited piece of fennel pith in a protecting sheath of reed. As a means of elucidating this academic point, it would be interesting to ascertain definitely the nature of the plant which is called νάρθηκα to this day by the inhabitants of Lesbos. Is it the giant fennel, or is it a reed, as stated by Bent?

In addition to the intrinsic interest of a nearly exhaustive *corpus* of myths detailing the varied ideas of various peoples all the world over, as to how the use and, later, the making of fire were discovered by man, there is the important bearing which the collation of such a mass of material has upon the wider ethnological problems. To the tracers of culture-affinities and culture-diffusion the data collected and presented in so masterly a manner, with the wealth of references to sources of information, will prove a valuable mine. Sir James Frazer has, indeed, by launching this new addition to his already powerful fleet of 'classics', increased materially the indebtedness of all those who study the problems of human culture.

HENRY BALFOUR.

Preparing Estimates for Ships.

The Design of Merchant Ships and Cost Estimating: a Treatise on Ship Design and Cost Estimating, giving up-to-date Methods of arriving at Correct Proportions, Form and Power to attain Minimum Capital Cost with Maximum Service Efficiency. By Alexander Kari. Second edition enlarged. Pp. xiv + 307. (London: Crosby Lockwood and Son, 1930.) 36*s.* net.

THE designing, constructing, and fitting out of a ship may be compared with the planning, building, and furnishing of a great hotel which, when complete, must be ready in all respects for the reception of both guests and staff. In both cases there are somewhat similar preliminary investigations to be made and equally elaborate calculations as to size, accommodation, materials, and cost, while at every turn strict attention must be paid to official regulations. How elaborate these calculations are in the case of ships is well shown in this book of Mr. Kari's on "The Design of Merchant Ships and Cost Estimating".

Ships not only differ in size, form, and speed, but also there are many special types of vessels all of which demand separate consideration. Passenger vessels, cargo vessels, colliers, grain carriers, oil tankers, refrigerated ships, ice breakers, cable-laying ships, dredgers, and tugs are examples of merchant ships built for special purposes, the designers of which must not only have a firm grasp of the principles underlying all naval construction but also a wide knowledge of the dimensions, performances, machinery, and fittings of vessels already on service. The collection of the data relating to the latter is one of the tasks of every draughtsman and shipbuilder, and the possession of such data is regarded as a valuable asset for the preparation of estimates. It is with this practical side of the subject that Mr. Kari has mainly dealt.

Commencing with a discussion of the choice of the type of hull to meet the shipowners' requirements, chapters are devoted to the determinations of a ship's dimensions, freeboard calculations, and to the general arrangements in cargo and passenger ships, the spacing of water-tight bulkheads, and to the various regulations of the British, French, Norwegian, German, and Italian authorities. The general design of the ship having been determined, the detailed estimates of weight and costs have to be made, and in Chapters x. and xi. not only are the weight and cost of the steel structure dealt with but also a complete review is given of the hundred and one items found in every ship. The cost of materials varies with the locality and state of the markets; the cost of labour depends on the grades of workmen, their labour efficiency, and the general efficiency of management. Under the title "Wood and Outfit" are included the cement work used for preservation of certain parts of the hull, the wooden decks, floors, ceilings, hatch covers, gangways, cabins, fittings, mess rooms; iron fittings such as anchors, davits, bollards, ladders, gratings, staunchions, rails; the various systems of piping, the painting, rigging, canvas gear, boats, deck machinery, navigation instruments, steering gears, winches, the electric installation and insulation. Further chapters deal with the size and weight of propelling machinery, with resistance and screw propellers, and with service performances.

The text is accompanied by more than a hundred

tables of data, and a series of diagrams, curves, and sketches, the latter ranging from outline diagrams of types of ships to sketches of deck and cabin fittings. The book is one which will no doubt be found of use on many occasions and of value as a work of reference for everyday use.

Diatoms: Satis superque!

Notes on Diatoms: an Introduction to the Study of the Diatomaceæ. Compiled by Frederick Beatson Taylor. Pp. ii + 269. (Bournemouth: The Compiler, 2a Montague Road, 1929.) 21*s*.

WHATEVER opinion may be held as to the general usefulness of such a book as the above, one pays homage to the industry and patience that went to its compilation. From Leeuwenhoek to De Toni, from 1703 to 1929, the author has ranged, collecting a mass of information that one piously hopes may be useful to the student of the group. Whether it assists in clearing up what Grunow described as "le chaos qui règne actuellement dans certains genres" is doubtful, and as an "Introduction to the Study of the Diatomaceæ" (which, by the way, is the title of Mills and Deby's book of 1893), it is much less useful than such a book as Hustedt's "Süsswasser-Diatomeen Deutschlands". Accompanying the book in a pocket at the end are five plates of illustrations of species, four being from outline drawings and one from photomicrographs; this last being by far the best of the plates.

The sixteen chapters contained in the book present the opinions, contradictory or unanimous as the case may be, of an army of authorities upon every phase of diatom life, many of the opinions being entirely obsolete and not a few grotesque. A loose sheet of corrigenda accompanies the volume, which, however, does not include all the corrections necessary; for example, the statement on p. 49 that Bailey dissolved valves of *Pinnularia* in *hydrochloric* acid. If the book is intended as a help to the beginner in the study of diatoms, the chapter on collecting and preparing diatom material might have been amplified and have included references to the excellent and practical directions for this work given in the books of Meister and Hustedt.

One cannot accept the statement made in Chap. iii., and repeated in Chap. viii., that the presence of diatoms in fresh water is an indication of its suitability for drinking purposes, and that a desmid flora should be regarded as a warning against doing so. I recently made a collection of diatoms from a farm-yard ditch that was largely contaminated with sewage, and the richest collection of diatoms I have ever made, both in species and individuals, came from a small pond the water of which no one would regard as potable. Whipple long ago gave examples of the fouling of water by a dense diatom population. On the other hand, desmids abound in lakes and reservoirs from which the water supplies of large towns are derived. Considerable space is devoted in the chapter on "Structure and Markings" to the controversial subject of 'resolution', but the beginner who reads the book as an introduction will probably be utterly lost amidst the contradictory opinions of the authorities quoted, many of which opinions are quite amateurish, and might well have been omitted in the interests of conciseness.

'Craticular' diatoms receive considerable attention from the compiler in this chapter. It is rather a cynical comment on the methods of some diatomists to find such forms elevated not only to specific rank but to genetic rank also, as in the case of the genus *Craticula* constituted by Grunow. There can be little doubt that they are the result of a pathological condition. I have a slide containing numerous specimens of *Navicula cuspidata*, one individual of which shows the 'craticular' state in one hemisphere of the frustule, the other being quite normal. That the condition has nothing to do with changes in the salinity of the water, as was suggested by Marpmann, may be inferred from the fact that the species above named, which seems to be especially liable to the 'craticular' condition, is a fresh-water species.

Chap. xi., "The Species of Diatoms", wherein the compiler brings together the opinions of many authorities on the desirability of limiting the numbers of species, and reducing the number already in existence, will be read sympathetically by those engaged in taxonomical work on the group. Probably nowhere has the manufacture of species and varieties gone to such absurd lengths as in the Bacillariales, and unfortunately it still continues. Dimensional varieties, and even pathological forms, abound in the various text-books, and every new authority contributes his quota to the confusion.

In "The Literature of Diatoms", to which Chap. xii. is devoted, is brought together in chronological sequence titles of practically all the principal works on the Diatomaceæ, with the dates of their publication, and useful notes indicating the ground covered by the authors. No reference, however, could be found to "An Introduction

to the Study of the Diatomaceæ", by F. W. Mills and Julien Deby, published by Iliffe and Son in 1893, which contains a valuable bibliography of diatom literature up to that date. When referring to Meister's "Die Kieselalgen der Schweiz", it is not made sufficiently clear that the work deals only with fresh-water species. A list of monographs on various genera and books relating to the diatom flora of special areas adds to the usefulness of the chapter.

A review of the genera of diatoms, with authors' names, and dates when the genera were established, is a chapter of the book that will prove of great service to historical students of the Diatomaceæ. References are also given to the principal works in which the genera may be found. No pains seem to have been spared to make this list as complete as possible, and an addendum to the chapter adds additional genera and references. This chapter is probably the best and most useful in the book. A good index is provided. G. T. HARRIS.

Our Bookshelf.

Mathematical Geography. By Prof. A. H. Jameson and Prof. M. T. M. Ormsby. Vol. 2: *Simple Astronomical and Trigonometric Surveying, and the more Advanced Study of Map Projections.* Pp. viii + 160. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 6*s.* net.

THE comment made in this journal on Volume 1 of this work was that it would be welcomed by geographers for its scope and clarity. The second volume has now appeared, and continues the treatment of map projections more fully and completes the course which the authors set out to cover. Vol. 2 deals principally with the astronomical determination of position on the earth, more advanced surveying, and a progressive advanced treatment of map projections. The influence of the spheroidal shape of the earth on map projections is also dealt with.

The book is in general clearly written and, in spite of its more advanced character, easy to follow. The illustrations are clear and suited to the requirements, although one may enter a protest against Fig. 33 and the elaborate dual deductions which follow therefrom. The section on photographic surveying, unfortunately, is only sufficient to indicate where a satisfactory treatment is to be obtained. Surely such a modern development was well within the scope of the work, and was deserving of more adequate handling.

Care has been taken in the preparation of the book—a feature evidenced by the freedom of the text from error. The examples and exercises which are included in the work are an additional commendation. This volume will be added to the list of useful books by all who are interested or concerned in this subject. J. ELING COLECLOUGH.

The Flood: New Light on an Old Story. By Harold Peake. Pp. x + 124. (London: Kegan Paul and Co., Ltd., 1930.) 5*s.* net.

MR. PEAKE'S book on the Flood is an account, intended primarily for a popular audience, of the bearing of recent archæological investigation on the legend of an all-destroying deluge. This legend is world-wide in its distribution; but it is best known in the version given in the Book of Genesis. The author accepts the view that a common origin for the various legends is not probable, but the Hebrew version was most certainly derived from the Mesopotamian epic of Gilgamesh brought back to Palestine after the Captivity. The discovery at both Ur and Kish of a stratum of clay of a thickness which could only be due to a considerable inundation has given reasonable ground for believing that the legend has here preserved a record of an historical event. With this as the basis of his argument, Mr. Peake expounds for the benefit of the public he has in view the wider question of the bearing of recent archæological research on the historicity of events once regarded as entirely mythical, but of which the record may now be regarded as enshrining an element of truth.

Although Mr. Peake's book is primarily intended to be of popular interest, scholars cannot afford to neglect it, for his account of the pre- and post-diluvian culture of Mesopotamia is suggestive in its interpretation of the difficulties which at present offer puzzles for the archæologist. Most ingenious of all, perhaps, and indeed a *vera causa*, is his suggestion that the discrepancies between the records and the archæological evidence relating to the early dynasties of Ur may have arisen from a misplacement of the tablets when the lists of the kings were copied.

The Book of Electrical Wonders. By Ellison Hawks. Pp. 316 + 41 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1929.) 7*s.* 6*d.* net.

ELECTRICITY has so many applications, and it is so much in evidence everywhere, that it may be presumed that few of the rising generation of boys and girls are without some knowledge of batteries, dynamos, telephones, and vacuum tubes. If the elementary principles are clearly explained, even the most complicated electrical machinery lends itself to popular exposition, and there is ample room for well-written books such as that by Mr. Hawks. Within the space of some 300 pages he has been able to include a great deal of interesting matter regarding power stations, electric lighting, electric furnaces and welding, telephones, telegraphs, radio communication, X-rays, photo-telegraphy and television. There are no fewer than 41 plates and 91 illustrations. It is a book which will no doubt find its way into the hands of many boys, and it is essentially one to be included in the school library. In the preface Mr. Hawks says that Faraday's annual salary probably never exceeded £100. One is happy to think Faraday was paid more than that, and moreover, had he been so minded, he might have made a fortune.

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.*]

Science and Philosophy.

THE leading article under this title in NATURE of June 7 is interesting not only in its exposition of the subject but also in marking a phase in the history of thought. Throughout what is for the circumstances a fairly full discussion there is only one reference to biology, and this in the form of a hint that the fundamental ideas of that branch of science are in especial need of critical examination. It is highly probable that in no such article written at the beginning of this century could the explicit reference to biology have been so slight both in substance and in tone. The occasion indeed brings into sharp prominence the extent to which the biological sciences have, during the last thirty years, lost prestige in the intellectual world, and ceased to influence philosophic thought. It is well that this fact, whether it ought to give rise to satisfaction or regret, should be clearly recognised. Nevertheless, however complete may be its intellectual insignificance to-day, the fact remains that in any attempted *rapprochement* between science and philosophy biology is still very much to be reckoned with, and not the less because during the late comparatively silent years it has been steadily adding to its store of knowledge, and especially in those of its branches that are specially relevant to the proposed work of reconciliation.

A philosophy is an attempt to bring into harmony the verifiable truth of science and the intuitive truth of the mind. That these two categories are, at whatever depth, identical is the assumption of the philosopher; it is also the assumption of the naïve intellect, but the notorious effect of secular experience is to make the supposed identity less and less superficially obvious. It was long thought that the two categories had a meeting place and common station in mathematics and that our intuitions of number and space did give us verifiable objective knowledge. This has remained true of number because apparently internal experience of number is as good as external experience of it; that is to say, abstract number is indistinguishable from concrete number. It cannot, however, any longer be accepted for space, for we now know that if the scale is large enough (and perhaps small enough) the intuitions we have formed on the strength of binocular vision and the so-called stereognostic sense are not all verified by experience. The developments in physics which are commonly supposed to have done so much for philosophy have thus, it would seem, incidentally taken away one of its time-honoured supports.

It is, however, the developments in the biological sciences that appear to have done most to increase the severity of the philosopher's task, though the retreat of biology from its former position in the world of thought has tended to obscure this fact.

In the reconciliation of verifiable and intuitive truth, the mind, if we may use a legal metaphor, is not only one of the parties to the action but also the judge. The knowledge that the last thirty years have given us of the limitations and liability to error of the mind in what we may call its judicial capacity, is therefore highly relevant and certainly not less so than the advances in physics, which in relation to philosophy have attracted so much more attention. That the wish is apt to be father to the thought, even in the highest and austerest activities of the mind, is no longer a mere proverbial tag but a scientific fact, and we now know that in appropriate circumstances desire can override all evidence. The work of Pavlov, again, little as its implications for man have been followed out, and strangely ignored as it has been by the philosopher, contains matter that may well have to be reckoned with in estimating the validity of human judgment, especially perhaps in regard to our sense of causation.

The biological conception of the mind as a natural product will have to be assimilated if philosophies in general are to lose those two characteristics which are so apt to discourage interest in them; first the tendency, however complete they may seem to their inventors, to prove intransmissible without gross modification, and secondly, the odd coincidence that after surveys of phenomena no matter how extensive and sublime, they so often but confirm the convictions and beliefs in which their inventors were bred.

These are some of the considerations which make it seem probable that, in any successful *rapprochement* between science and philosophy, biology will have a more active part to play than merely to submit to the critical overhaul of its scientific concepts.

WILFRED TROTTER.

June 10.

Developmental Mechanics of Chicken and Duck Embryos.

IT has recently proved possible to cultivate young chicken and duck embryos *in vitro*, using the 'watch-glass technique' employed at the Strangeways Laboratory for the cultivation of embryonic organs. Experiments using a somewhat similar technique were made in this laboratory two or three years ago by T. S. P. Strangeways and D. H. Strangeways, but the work was given up after a few trials and the results never published. The embryos can easily be kept alive for two or three days and differentiate nearly normally, although the rates both of differentiation and of growth are slower *in vitro* than *in vivo*. I wish here to summarise some experiments which I have recently performed on this material: full reports will be published in the near future.

At the stage when the primitive streak is fully grown but the head process has not yet appeared, the blastoderm can be removed from the yolk and the endoderm and mesectoderm separated from each other. So far the isolated endoderm has never given any signs of differentiating *in vitro*, but the mesectoderm will form neural folds, somites, and a notochord. If the endoderm and mesectoderm are separated and then brought together again in such a way that their original longitudinal axes are approximately at right angles, it is found, in chick embryos of the above age, that the embryo develops in the direction of the ectodermal axis, and that the endoderm forms a foregut in the correct place as determined by the ectoderm. However, in a similar series of experiments on considerably less developed duck embryos, in which the primitive streak was not fully grown, that structure, as it lengthened and grew forward, was bent round towards the anterior part of the endoderm: in later stages the embryos became straight, lying in a direction midway between those of the ectoderm and endoderm. This result appears to indicate that both the layers have a polarity, and that under the conditions of these experiments, both layers play a part in the determination of the axial direction of the embryo.

If two mesectoderms, from two chick embryos of

the primitive streak stage, are placed with their ventral (mesoderm) surfaces together and are cultivated in that position, it is found that the primitive streak of the lower mesectoderm induces neural folds in the upper mesectoderm, which thus comes to have two sets of folds, its own original set and the induced set. Probably the induction is mutual, each mesectoderm acting on the other, but as the lower mesectoderm rapidly degenerates, perhaps for lack of oxygen, this cannot be determined with certainty. If there is a considerable difference in the degree of development of the two mesectoderms, the younger appears unable to induce neural folds in the older. In several cases, in which an older mesectoderm has induced neural folds in a younger mesectoderm, and in which the direction of the induced folds was at right angles to that of the younger primitive streak, the younger primitive streak has failed to develop, and only the induced neural folds are present in the upper mesectoderm. As in the amphibia, the organising power is not species-specific, since a duck primitive streak has induced neural folds in chick tissue, and vice versa.

Grafting experiments, in which pieces of primitive streak, cleared of endoderm, have been planted upside down between the endoderm and mesectoderm of a host embryo, have shown that the organising power can be manifested by such isolated pieces : this result can be taken as fairly definitely proved for the anterior end of the primitive streak including the primitive pit, but it is not yet entirely certain for the posterior part isolated from the primitive pit. Here, again, certain grafts between the duck and chick have been successful. These grafting experiments also make it clear that a developing neural tube can induce the formation of somites from mesoderm which normally would not form such structures. It is hoped to perform similar grafts in the near future using the endoderm underlying the primitive streak.

The phenomena described in the last paragraph, in which the primitive streak is found to induce neural folds, that is, primitive streak derivatives, are perhaps more nearly comparable to the 'homoiogenetic induction' of medullary plate by medullary plate in Triton than to induction by the dorsal lip of the blastopore.

The hypothesis that the organising capacity of the primitive streak is inherent to some extent along its whole length, which is suggested by the grafting experiments, is also supported by the fact that if any part of the primitive streak is removed, regeneration takes place and in many cases a perfect embryo results. The more posterior the piece removed, the easier it is regenerated. The head rudiment can also be regenerated, presumably under the control of the primitive streak. In this case the regeneration is usually incomplete : two half-heads are first formed, one on each side of the hole made by the operation, and these later fuse more or less well : in such cases, the two heart rudiments may be prevented from fusing and two beating hearts are developed ; it is not yet certain how far regulation goes on in the half-hearts, which are bent, and are mirror images of each other. In contrast to the regeneration of the head under the influence of the primitive streak, it is found that if the entire primitive streak is removed, including the primitive pit and Hensen's knot, it is partially, and sometimes quite considerably, regenerated.

A certain amount of work has been done showing that regenerative processes can take place at a considerably later stage : thus if the eye-cup and lens are removed from a 15 somite embryo, a regenerated cup and lens are formed which are at least morphologically perfect.

It will be seen that the developmental mechanics of the chick blastoderm are decidedly complicated. Probably there are several regions capable of acting as organisers in Spemann's sense, and, notwithstanding Hoadley's demonstration (*Jour. Exp. Zool.*, vols. 42, 43, etc.) that some self-differentiation of parts of the blastoderm can be obtained from very early stages, it seems to be true that the blastoderm retains for a considerable time enough plasticity to be affected by such organising regions. As yet little is known about the limits of this plasticity, and not very much about the distribution and potentialities of the organisers, though in the latter case perhaps enough is known to suggest a comparison with the gradient of susceptibility to poisons found by Hyman (*Biol. Bull.*, vol. 52).

C. H. WADDINGTON.

Strangeways Research Laboratory,
and Dept. of Zoology, Cambridge,
May 24.

Researches on the X-Ray Spectrum of Sulphur.

SOME results of an investigation of the effect of chemical constitution on the X-ray spectrum of sulphur have recently been published by me (*Zeit. f. Phys.*, **60**, 642 ; 1930). As shown by Lindh and myself (*Ark. f. Mat., Astr. och Fysik*, **18**, Nr. 14 and 34 ; 1924 ; *Zeit. f. Phys.*, **33**, 901 ; 1925), the structure of the $K\beta$-lines of the elements sulphur and phosphorus does not depend only on the chemical state of the element under investigation, but also on the material used for the anticathode. For some time I have been studying more closely this influence. Some preliminary results obtained with sulphur, using aluminium for the anticathode, will be described here. Of the various chemical compounds photographs are taken under the same experimental conditions as those in the work above mentioned (*Zeit. f. Phys.*, **60**, 642 ; 1930), where copper was solely used for the anticathode.

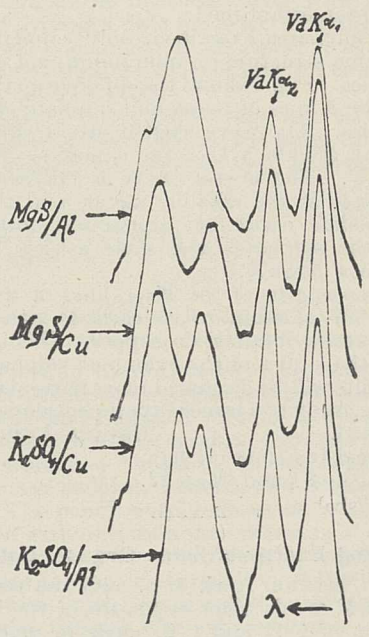

FIG. 1.

On an aluminium anticathode magnesium sulphide gives except a rather intense β-line with the wavelength 5017·9 X.U. also a fainter, somewhat diffuse one of 5023·6 X.U. The difference in structure between

the β-lines of magnesium sulphide on copper and on aluminium anticathodes is obvious from the photometer curves in Fig. 1. The two lines at the right part of the figure are $K\alpha_1\alpha_2$ of vanadium, which are taken as reference. The photographs of calcium suphide show a rather sharp line at 5018·1 X.U., which towards greater wave-lengths seems to have a faint component at about 5021 X.U. With strontium sulphide and barium sulphide the β-lines have almost the same structure as on copper anticathode. However, the line 5018·3 X.U. with strontium sulphide on copper anticathode seems on aluminium to be separated into two lines. Also a very faint line at 5011 X.U. is visible with these two compounds. The broad emission bands, which were obtained with zinc sulphide and cadmium sulphide on copper anticathode are on aluminium separated into two lines, one rather broad and intense at 5017·1 resp. 5017·0 X.U. and one fainter at 5023·2 resp. 5022·1 X.U. Further, the photographs of zinc sulphide show a faint line of 5031·3 X.U. and those of cadmium sulphide one of 5033·0 X.U. At a closer investigation of the photographs of zinc sulphide and cadmium sulphide on copper anticathode here also small traces of these fainter lines are visible. Of the sulphides examined only copper sulphide holds its characteristic β-doublet structure unmodified on aluminium anticathode. The peculiar structure of silver sulphide on aluminium (*l.c. Ark. f. Mat., Astr. och Fysik*, **18**, Nr. 34; 1924) has anew been established.

Of the sulphates examined, only copper sulphate has the same structure on aluminium and on copper anticathodes. Fig. 1 shows the difference in structure between the β-lines of potassium sulphate on the two anticathodes. The wave-lengths are on aluminium: 5018·4 and 5014·9 X.U.; on copper: 5020·6 and 5014·7 X.U. The lowest curve is characteristic of the sulphates of the alkaline metals and the metals of the alkaline earths on aluminium anticathodes. Some of the sulphates also show a very faint and diffuse line of 5044 X.U.

The wave-lengths of the $K\alpha_1\alpha_2$-lines of the various sulphides on aluminium anticathode agree closely with the results obtained on copper. This is also the case with the α-lines of the examined sulphates.

The results will be discussed more particularly when the present study of a larger experimental material has been finished.

OSVALD LUNDQUIST.
Physical Institute of the
University of Lund, May 22.

The Binding Energy of Some Organic Compounds.

MECKE (NATURE, April 5, p. 526) has recently revised several of his older estimates of the energy of dissociation of C-H and C-C bonds in organic compounds, obtaining values considerably higher than before. In these new calculations it is assumed that (*a*) the energy of removal of all of the hydrogen atoms in, say, methane, is the same, and (*b*) the carbon atom will be left in the ^5S state with an excess energy amounting to about 110 kcal. It is then possible to calculate binding energies by the same methods which had been used before when instead of (*b*) the assumption was made that a normal carbon atom would be formed; clearly, the new energies will be higher than the old by 110/4 or 27·5 kcal. for C-H bonds, and 110/2 or 55 kcal. for C-C bonds. The dissociation energy for C-H in saturated hydrocarbons is thus increased from 90 kcal. to 117 kcal., and that of C-C from 65 kcal. to 120 kcal.

This value for C-H may well be correct for methane, but it is probably too high for the higher hydrocarbons; in support of this opinion the experiments of Bonhoeffer and Harteck (*Z. physik. Chem.*, **139A**, 64; 1928), may be mentioned; it was found that methane was perfectly inert to atomic hydrogen, but that all higher hydrocarbons were dehydrogenated, suggesting that the binding energy of the C-H bond in methane is greater than the heat of dissociation of hydrogen, 101 kcal., while in the higher hydrocarbons it is less.

The value 120 kcal. for C-C is even more difficult to reconcile with chemical data. It has become clear within the last few years that the initial step in the thermal decomposition of saturated hydrocarbons takes place as a normal unimolecular reaction; the best value which can be given for the energy of activation in such reactions is about 65 kcal. It is rather likely that the binding energy of the bond which breaks in a unimolecular reaction is about equal to the observed activation energy, but in any case it cannot be greater than this energy plus the average energy of the reacting molecules at the temperature used. For propane at 600° this later quantity will scarcely exceed 10 kcal., giving about 75 kcal. as an upper limit for the energy of a bond in this molecule. It is not likely that there are any C-H bonds with so low an energy as this, and it may therefore be assigned to a C-C bond.

The conclusion which these facts suggest is that the old, lower values for the C-C bond, and for C-H in higher hydrocarbons, are preferable, and therefore that the complete dissociation of such hydrocarbons will yield carbon atoms in the normal ^3P state.

LOUIS S. KASSEL
(National Research Fellow).
Gates Chemical Laboratory,
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April 18.

Negative Attenuation of Wireless Waves.

IN 1926 Ratcliffe and Barnett (*Proc. Camb. Phil. Soc.*, vol. 23, p. 300) directed attention to an anomalous effect which they had observed when measuring the attenuation of wireless waves of 1600 m. wave-length from 5XX, the Daventry station of the B.B.C. They obtained an attenuation curve of the form shown in Fig. 1, which shows how the product ($E \times d$) of the

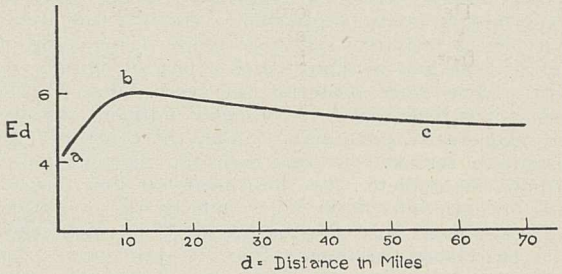

FIG. 1.

distance (d) and the electric intensity in the wave (E) varied as the distance (d) from the transmitter was increased. The falling portion (bc) of the curve represents, as is well known, attenuation of the waves due to losses produced by eddy currents flowing in the ground. The rising portion (ab) of the curve may be said to represent a 'negative attenuation' of the wave. At the time when the observations were made, no explanation of the negative attenuation could be given.

Since the publication of the original results, experiments have been performed to find out whether the negative attenuation effect is peculiar to the Daventry signals, or whether it occurs on all signals of this wave-

length. Attenuation measurements made at Cambridge on a transmitter with a low aerial, working on a wave-length near 1600 m., showed no sign of the effect. We therefore conclude that it is due to some special conditions at the Daventry site. Two possibilities then present themselves: either it may be due to the high aerial employed at Daventry (130 yd. high), or it may be due to some special factors influencing the attenuation at the Daventry site. It would be possible to decide between these two alternatives by investigating the attenuation at Daventry using a low transmitting aerial. By kind permission of the B.B.C. it is hoped to carry out this measurement in the near future. In the meantime, it is of interest to investigate whether the effect could be produced by some peculiarities of the ground over which the wave passes. This investigation can be carried out with the aid of some numerical calculations on Sommerfeld's attenuation theory (*Ann. der Phys.*, vol. 28, p. 665; 1909) which have recently been published by Rolf (*Proc. Instit. Radio Eng.*, vol. 18, p. 391; 1930).

Rolf shows that, for certain values of the conductivity (σ) and the dielectric constant (ϵ) of the ground, we should expect attenuation curves of the form shown above, exhibiting the phenomenon of negative attenuation. By comparison with these calculations we find that the observed curve can be explained if we assume $\sigma = 7 \times 10^{-15}$ e.m.u. and $\epsilon = 80$ e.s.u. The value for σ is not very different from that which has previously been found by other methods (tilt of the wave-front, and attenuation on 400 m.). The value of ϵ is, however, very different from that found previously (Ratcliffe and Shaw, NATURE, Oct. 19, 1929, p. 617), using waves of 30 m. wave-length. We must, however, remember that there is every reason for supposing that both σ and ϵ will vary with frequency. To investigate this variation, laboratory experiments have been carried out, in which these quantities were measured at different frequencies, for different specimens of soil. It was found that ϵ increases as the frequency is reduced, and at 1600 m. values of $\epsilon = 45$ were obtained for this quantity, and it was noticed that for these frequencies, the value of ϵ was increasing rapidly as the frequency was diminished. It thus appears that here we have a possible explanation of the negative attenuation effect.

Whether or not this is the correct explanation will only be clear when the measurements on a small aerial at Daventry are completed, and only then will we know whether the values $\sigma = 7 \times 10^{-15}$ and $\epsilon = 80$, deduced from the curve in this way, are correct.

J. A. RATCLIFFE.
F. W. G. WHITE.

Cavendish Laboratory,
Cambridge, May 21.

New Spectrum of the Hydrogen Molecule.

IN a recent note (*Physical Review*, May 1, 1930) I stated that I had observed a new system of absorption bands in hydrogen. Since, because of its primitiveness, the hydrogen molecule is of great interest to physicists and chemists, I hasten to make these data available to other workers in this field. Although at present the data are incomplete, I hope they are accurate enough to help investigators to establish another link between the ultra-violet and the visible spectra of hydrogen and help clear up more of the ultra-violet many-line spectrum.

The new band system is especially interesting because it probably arises from the normal (A) state of the hydrogen molecule, and is by far the most intense of the hydrogen absorption spectra. The observed bands are degraded to the red and form a v'-progression representing transitions to vibration states connected with a new electronic level. In harmony with former usage in the case of hydrogen absorption spectra, and pending a fuller investigation to establish its character, I shall call the new electronic level the D-level. The preliminary examination of this spectrum yields the following data. The quantum designations, wave-lengths, and intensities of the observed bands are: (0, 0) 838·62 (6); (1, 0) 825·85 (5); (2, 0) 814·32 (4); (3, 0) 803·86 (3); (4, 0) 794·23 (2); (5, 0) 785·75 (1); (6, 0) 778·18 (0); (7, 0) 771·35 (0). The formula that represents these is

$$\nu = 119244 + 1900v' - 59{\cdot}524v'^2,$$

where ν is the observed frequency and v' the vibrational quantum number of the D-level. From these data it is seen that the molecular constants are $\omega_0 = 1900$ cm.$^{-1}$, $\omega_0 x = 59{\cdot}52$ cm.$^{-1}$, and $D = 1{\cdot}872$ volts, the energy of dissociation from the D-state of the molecule.

Using the value 4·465 volts as the heat of dissociation from the normal state in connexion with the data given above, one sees that the products of dissociation are a normal atom and one excited to the 3-quantum state. The value thus deduced for the 3-quantum state of the atom is 12·22 volts, whereas the true value is 12·035. The discrepancy is not large, and is in the right direction when one considers that a linear formula was used to fit the data of the ω_v-curve. A further comparison of these data with the great amount of hydrogen data made so conveniently available by Prof. Richardson in his report to the Faraday Society shows that the D-level is quite new and that its denominator is 4·538.

Some recent photographs showing some of the rotation lines of these bands are being examined in order to extend the analysis and to attain greater accuracy.

J. J. HOPFIELD.

University of California,
May 20.

Association of Stimuli in the Development and Function of the Nervous System.

AN interesting connexion is to be found between two recent conceptions of the nervous system, in its development and function. Pavlov's work indicates that the function of the cerebral cortex is the setting up of conditioned reflexes. These, together with unconditioned reflexes, underlie the behaviour of an animal. The conditioned reflexes are elaborated by association with unconditioned reflexes; "their function and extinction are determined by (one or several) coincidences in time of stimulation of the lower lying reflex centres, with the stimulation of the cerebral hemispheres through the corresponding centripetal nerves" ("Lectures on Conditioned Reflexes", p. 74). The *association* of stimuli (those causing unconditioned with those causing conditioned reflexes) is a fundamental factor in the nervous activity of an animal. For example, the ringing of a bell will cause a dog to salivate (conditioned reflex) provided the sound of the bell has previously accompanied contact of meat with the dog's mouth, causing salivation (unconditioned reflex). It is the simultaneous or approximately simultaneous occurrence of different stimuli which is responsible for the creation of the conditioned reflexes constituting animal behaviour. Thus the *function* of the cerebral cortex is dependent upon the concurrence of physical stimuli.

Compare this with the theory of neurobiotaxis, formulated by C. U. A. Kappers, which accounts for the *development* of the nervous system, and the material connexions in it. In this case, associated

physical stimuli from various regions of a growing embryo are thought to determine the formation of the parts of its nervous system. Kappers says: "In the case of material alterations in the nervous system, only simultaneously associated influences cause the selection . . . simultaneous (or immediately successive) stimulations bring about not only mental associations but also material connexions in the nervous system" ("Three Lectures on Neurobiotaxis and other Subjects", p. 19).

It appears from the experimental work of Pavlov, Kappers, and other workers, that both the development of the nervous system and the function of its highest part, the cerebral cortex, are dependent fundamentally upon the occurrence of physical stimuli associated with each other in space and time. The importance of this conception for science is obvious. Since the mind is dependent upon the activity of the cerebral cortex, these recent theories of its development and function may not be below the consideration of philosophers.

R. L. WORRALL.

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The Neon Lamp as a Glow Relay.

THE ordinary 'Osglim' neon lamp as made by the General Electric Co., Ltd., forms a convenient and sensitive glow relay if furnished with a third electrode which may take the form of a strip of metal foil 1½ in. wide, pasted on the outside of the lamp to surround the internal electrodes. The type of 'Osglim' lamp most suitable is that known as the beehive, in which the electrodes take the form of a disc and spiral.

This form of glow relay is sometimes conveniently used in conjunction with a photo-electric cell, to indicate when a required light intensity is falling upon the cell.

The disc electrode of the lamp is connected to the negative end of a battery, and the voltage adjusted on the spiral until the glow discharge is just avoided; usually about 132 volts is sufficient.

The external electrode of the neon lamp is connected to the cathode of the photo-electric cell, and the anode of the cell to a suitable positive tapping on the same battery. Illumination of the cell will then promote discharge within the neon lamp passing sufficient current to operate a magnetic relay.

The glow relay with the external third electrode enables two circuits to be kept entirely separate from one another. Not every 'Osglim' neon lamp is suitable, due to variations in the insulation resistance and probably also to less suitable gas pressure.

These neon lamps also exhibit a photo-electric property; if the voltage on the third electrode is just raised sufficiently to produce the discharge, illumination of the electrodes by, say, a gas-filled lamp will prevent but not discontinue the discharge.

L. BELLINGHAM.

71 Hornsey Rise,
London, N.19, May 23.

'Digging' in Rowing.

IN most cases where a solid moves through a fluid, the total force of the fluid on the solid is nearly opposite to the direction of relative motion. There is an exception in the case of a flat body such as an aeroplane wing, with its plane at a small angle to the direction of relative motion. In that case the force is nearly at right angles to the direction of relative motion, and provides the means of keeping the aeroplane up. If, however, the plane is too steeply inclined to the direction of motion, the force is again, as in ordinary cases, nearly against the motion, and we have the condition of 'stalling'.

In rowing, the object is the opposite one, to keep the force as far as possible against the relative motion; but it seems to be worth while to point out that an oar can be turned into an aeroplane. Imagine the blade inserted thus, and moved from right to left,

the blade being slightly inclined to the surface of the water. Then the same theory applies as for an aeroplane wing, except that the leading edge is now the lower one. Hence the force due to the water is *downwards*. But the force due to the oarsman's pull is in the direction of motion, and no steady motion in a horizontal direction is possible. If, on the other hand, the blade descended vertically, the force due to the water would become a resistance acting upwards. It will be seen on a little consideration that the only possible motion is an accelerated one nearly in the plane of the blade, and resisted almost only by skin friction. Thus the oar will rapidly shoot down to a considerable depth, while doing little to propel the boat.

The phenomenon is, I understand, not unfamiliar to oarsmen, especially when the blade is left near the 'feathered' position when reinserted in the water.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

The Accuracy of a Moth.

THE square case made by the female of *Amicta quadrangularis* for pupation offers a good example of the ability for accuracy. The case is about 1·1 inch long, and 0·2 to 0·3 square, formed of bits of grass stem broken off, and built in courses around the larva. The diagram (Fig. 1) shows the mean size of the

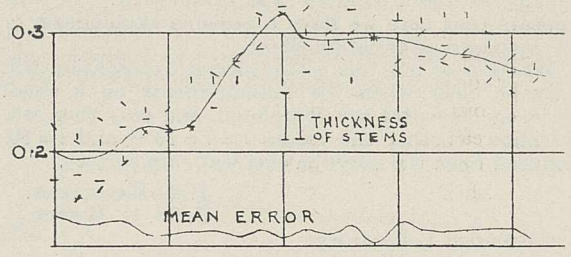

FIG. 1.

pieces beginning at 0·2 inch, widening to 0·32, and tapering to 0·27. The lengths of stem used on different sides are distinguished by four directions of the cross strokes. It will be seen that the mean error, separately drawn below, begins at 0·02 and diminishes to 0·01, while the thickness of the stems varies from 0·04 to 0·02 inch. The larva, therefore, makes an average error of only one-half the thickness of the stem, and estimates the required length for the position usually to 0·01 inch, including the error of cutting; this precision is kept up for nearly a hundred repetitions. A few layers near the beginning are omitted, as they overlap so that the ends are not clear. The habitat is in the desert of South Palestine about ten miles south of Gaza.

FLINDERS PETRIE.

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London, N.W.3.

The 1851 Exhibition Commissioners and their Work.

THE Commissioners for the Exhibition of 1851 have published records of their scholarship schemes and the Press has directed public attention to prominent features in the results of the work of the Commissioners in this section of their activities. The *Times*, in referring to the remarkable results of the first and greatest of these schemes, has paid tribute to the foresight of the chief promoter of the Exhibition—Prince Albert. The tribute is indeed well merited. It was due to the Prince's vision that the Royal Commission was established for the Exhibition and was continued thereafter on a broader basis and with powers that enabled it to function to public advantage—with results perennial and far beyond the scale of its own material resources.

Science Research Scholarships.

The essential factor in the influence of the Commission is its powers of initiation and demonstration. This feature is well illustrated by the scholarships' scheme, which did not take shape until forty years after the establishment of the Commission. In the course of these years the Commissioners had done a great deal to inspire the development of 'system' in national services for the promotion of science, art, and the industries; they had secured an estate in South Kensington as a 'locality' in which the State and other authorities could erect central institutions pertinent to such services.

It is clear that in the 'eighties the Commissioners came to the conclusion that *men* were lacking for the further development of their ideals; and the occasion produced the man who could find and 'make' such men—Lord Playfair—as Dr. Lyon Playfair, a commissioner from 1869. He acted as honorary secretary from 1883 to 1889, and in that period he carried through a process of financial change which replaced a deficit of the Commissioner's income in 1883 by a surplus of £5000 in 1889. He originated the Science Research Scholarship scheme, and, as chairman of the Scholarships' Committee for its first five years, he may well be said to have established the scheme.

The governing statement of that scheme is that the scholarships are "awarded to students who have passed through a university curriculum and have given distinct evidence of capacity for original research—to enable them to continue the prosecution of science, with a view to its advance, or its application to the industries of the country". From its inception the scheme took cognisance of students of universities overseas as well as of those at home. Right well has the scheme justified itself! The published "Record of the Science Research Scholars" gives ample evidence of the great and varied field the scholars have helped to enrich.

Conceived and maintained with full expectation of concurrent advance in the standard of preparation provided in the universities, the scheme met the needs for thirty years. In 1922 it was revised in view of the large development that had then taken effect in universities. From that year the awards have been under two categories: (*a*) Overseas Scholarships for selected students of universities in Canada, South Africa, Ireland, Australia, and New Zealand; (*b*) Senior Studentships for selected students of exceptional promise and proved capacity for original work. The Commissioners make their awards by selection in view of the recommendations of the institutions submitting names of candidates.

It will be noted that the change made in 1922 reflected a marked and welcome advance in the standards attainable within the limits of the facilities prevailing in the universities of Great Britain. By 1922 the universities had indeed been enabled to extend very materially the facilities they provided for advanced study and research—alike as to accommodation, facilities, and expert supervision and guidance. This provision has since been steadily increasing; in the past five years gifts from private benefactors and the financial help of the State through the University Grants Committee have made possible in the universities many advances in facilities and on staff that were, twenty years ago, but dreams.

The "Record of the Science Research Scholars" of the Royal Commission is remarkable—giving, as it does, for each 'scholar' particulars of his subsequent career. The pages of the list of scholars sparkle with names that call up most fruitful contributions to the progress of science! And, where personality counts for so much, it is refreshing to see in how many and how varied paths of life and lines of work these ex-scholars have rendered yeoman service and have been much sought after. Here is but a bare indication: yet even this is illuminating:—From 1891 to 1929 the number of those who passed out of their scholarship period is 562. Of these 7 died before obtaining scientific posts and 5 discontinued scientific work on the expiration of their scholarships. Of the 550, 240 engaged in teaching in universities (109 of them in the British Isles, 99 in the Dominions and India, 26 in the United States, and 6 elsewhere); 29 engaged in teaching in technical colleges and schools; 54 in research in universities; 91 entered public services, and 136 engaged in industries.

In reading these figures it must be remembered that a large proportion of those who become engaged in teaching continue their research work, and that not a few of these render expert assistance to industry; and, again, 'public services' to-day call for much specialised research which, in one way or another, reacts on industry. Indeed, careful reading of the detailed statements of the "Subsequent careers of Scholars" shows that their services to industry are both surprising and ubiquitous. The Record must be read: it is a document of great human interest.

Incidentally, the tabulated statements afford ample evidence of the extent to which the work of the 'scholars' has earned for them the appreciation of their fellow-workers in science and in the

industries. To take one example : 32 who had been ' scholars ' are noted in that Record as having been elected fellows of the Royal Society, and this year's election has added 3 more.

The Cost and How it has been Met.

Now what does all this cost ? The Senior Studentship and the Overseas Scholarship Schemes —together replacing the previous Science Research Scholarships Scheme—cost £11,000 a year. This annual expenditure is greater than the interest on the whole capital of the Commissioners in 1852 ; and the Commissioners support other educational ladders.

The surplus on the accounts of the 1851 Exhibition was £186,000, and the Commissioners have contributed liberally in sites and subsidies for the promotion of education in science and art—in every case deliberately and, with rare exceptions, with most fruitful results. The particular case of the Science Research Scholarships illustrates the discriminating care the Commissioners exercised in initiating the service forty years ago and their continuing attention to the purpose and conduct of the scheme. This particular scheme was—at its inception—a new departure and called for skilled and careful preliminary inquiry. In these respects it was typical of most of the schemes they furthered or initiated. When conceived, however, it had to face a particular difficulty. In a later section of these notes it is stated that in 1877 the Commissioners aimed at establishing scholarships, but they could not then do so. They had first to pay off debt incurred in developing their estate—the reserved part for public benefit ; the outer ring for sale or long leases. The Scholarship Scheme had to wait until they could float it—by the materialising of their area plan.

The fact is that from 1850 the Commissioners have been ' Venturers '—not ' Merchant Venturers', but venturers in ideas relevant to progress in science, art, and industry. The Science Scholarship Scheme was one of their ' ventures '—one of many. It has been dealt with *here* as a type, and *now*, because its results have just been subjected to a long-term audit. Its place in the labours of the Commissioners, and in the unwritten and, indeed, impossible estimate of the services they have rendered to intellectual and material progress, can be visualised only by a wide survey of their work.

The purpose of the following notes is to indicate briefly the record of their other ventures and to point to prominent achievements either by way of marking out promising fields or in exploring and testing little-known paths that might prove valuable lines to progress.

The Royal Commission of the Exhibition of 1851.

The present generation does not know the debt of gratitude it owes to the men who, in 1850, were incorporated as " The Royal Commission for the Exhibition of 1851 " ; nor, indeed, did the previous generation. Those of *three* generations ago credited the Commissioners with great energy and sound judgment in promoting the success of the Exhibition. After " 1851 " had set men a-thinking, many noted with pleasure the continuous effort of the Commission to secure the full fruits of the ideas the Exhibition had sown widespread. Quietly but steadily fruits were garnered and fresh areas enriched.

How came it that the Exhibition could prove so effective a stimulant and how did its influence become permanent ? The Commissioners appointed in 1850 were picked men—selected as representing the best and most active powers in many types of work—and they had in their chairman, Prince Albert, one familiar with the aims and methods in view—immediately and ultimately—one quick to understand conditions and energetic in securing action on decisions reached by the team he led. The Prince Consort had been president of the Society of Arts for some years, in the course of which that Society had made a good beginning in the exhibition of British manufactures. The Society proposed for 1851 an Exhibition of an international character and petitioned Royal sanction for the undertaking. The Royal Commission and the Charter of Incorporation were issued early in 1850.

The Exhibition.

The Commissioners got to work at once. They secured strong committees for the activities required at headquarters, and local committees were appointed in 297 towns and districts. " Several gentlemen were selected to visit the more important towns." The newspapers gave valuable aid. Despite many difficulties the Exhibition building—soon commonly known as the Crystal Palace—was erected on a site to the east of that on which the Albert Memorial now stands.

The Exhibition was opened on May 1, 1851, by Her Majesty Queen Victoria.

The Commissioners had worked hard : they had gathered an able staff and they had roused enthusiasm in all centres of population, manufactures, and industry in Great Britain and Ireland ; they had established relations with foreign countries and had elicited hearty and instructed co-operation in very many centres.

The building was ready in good time. The Exhibition contained contributions from nearly 14,000 exhibitors ; of these, 53 per cent were from the United Kingdom and Dependencies and occupied 65 per cent of the total exhibition space, while 47 per cent were foreign and occupied 35 per cent of the space. The exhibition was indeed international.

These figures are taken from the " First Report of the Commissioners ", published in 1852—a report which is a mine of interesting information : it embodies many instructive details of arrangement and propaganda, of precaution and of record. One inconspicuous item of record may be mentioned as affording an early example of the graphical illustration of related statistics. This is a sheet of three diagrams printed in colours : " Fig. 1. Diagram showing fluctuations in the number of visitors, as affected by different days of the week,

different scale of payment, rain and heat of the building". "Fig. 2. Diagram showing the relative fluctuation [in the numbers of visitors] on different days of the week [in successive months]." "Fig. 3. Diagram showing the number of visitors actually in the building at every hour on three separate days". There is much of human interest in the appendices to the Report.

In the body of that first Report, April 1852, the Commissioners stated that the surplus of the Exhibition accounts after the discharge of every liability would be not less than £150,000. The one major point of uncertainty then was the disposal of the Exhibition building, which had to be removed from Hyde Park. In the end the "Crystal Palace" was bought by the "Crystal Palace Company", which had been formed for this purpose. That Company took down the building and re-erected it at Sydenham.

The Surplus.

When the Commissioners closed the Exhibition account in 1855, the amount at the credit of the account was £186,436 18*s*. 6*d*. This sum was then transferred to their Estate account, which had been opened by that time. In the early months of the Exhibition it had become clear that there *would* be a surplus, and that this might be considerable. It is on record that the Prince Consort was giving close attention to this matter in August 1851. Soon after the close of the Exhibition the Commissioners petitioned Her Majesty for a supplemental charter enabling them to prepare and submit a scheme for the application of the surplus, and, if their scheme were approved, to put it in operation. Such a supplemental charter was granted on Dec. 2, 1851.

The Commissioners early satisfied themselves that no substantial national advantage would accrue if they were to distribute the surplus—as they had been pressed to do—among the areas that had contributed to the success that had attracted receipts. They had made a careful survey (Second Report, 1852) of the existing position as to central and local institutions working in the interests of science, the arts, manufactures, the raw materials and the processes required in industries. They had come to the conclusion that the most urgent needs were (i) improved conditions for the work of central institutions and (ii) the wide spreading of effectual methods of education and investigation bearing on these interests. By their effective propaganda work in the preparation of the collections for the Exhibition, they had prepared the people and the Press for a forward movement in these matters. The Exhibition itself had done much to stimulate thought and action which, well guided, might go far in its results.

After the Exhibition—The Estate.

The assets of the Commissioners as disclosed in their Report of November 1852 were, in fact, their surplus *and* an idea. The surplus was highly gratifying: the idea was of even greater value.

'System and a Locality' was their watchword. They urged more systematic facilities for study and advance in science, the arts, and industries. They proposed to find room for central developments on a systematic basis, and to leave to individuals, corporations, and authorities the promotion of the different interests that concerned them. They had themselves taken preliminary steps to secure a 'locality'. In 1852 they arranged to purchase, at a cost of £60,000, the Gore House estate of 21½ acres. Profiting, however, by the unfortunate experiences of other authorities in acquiring property in London, and knowing that the Government had been repeatedly urged by Parliament to provide an extension of national institutions, they took steps to secure national control of a larger area than was required for their own purposes. They passed a resolution authorising the outlay of a sum not exceeding £150,000 of the surplus in the purchase of land, including the Gore House estate, on condition that the Government would recommend Parliament to contribute a like sum towards the purchase of land on terms to be arranged. The Government gave this assurance. The de Villars estate and portions of the Harrington estate were purchased under this agreement, which, in practice, amounted to a temporary partnership. These purchases enabled the Commissioners to lay out this group of properties for buildings of determined types, and to construct roads on a scale conformable with their general scheme.

Locality.

Their scheme contemplated that there should be preserved for public purposes: (*a*) almost the whole of the area extending between the Queen's Gate of to-day on the west and Exhibition Road on the east, and from Cromwell Road on the south to the site on which the Albert Hall now stands; (*b*) the south-eastern block of land now identified with the Victoria and Albert Museum.

The latter block of land was taken over by the Government for £60,000 in 1861. The iron building that formed the nucleus of the South Kensington Museum—now the Victoria and Albert Museum—was erected on it in 1857, and was formally visited by H.M. Queen Victoria and Prince Albert, previous to its opening to the general public. Further, more permanent, sections surrounding the garden court were erected in the course of years, and the main building which occupies the south and west fronts, and indeed the major part of the site, was opened by H.M. King Edward VII. in 1909. The other buildings on this section of the area are on its north-western corner: these are the original building of the Royal College of Science on the Exhibition Road front, and the Royal College of Art behind.

In 1864 the Government bought from the Commissioners, for £120,000, the ground in the centre of which the Natural History Museum now stands. On the north-eastern corner of this area the new building for the Geological Survey and Museum is now in course of erection.

In 1888 the Government took over from the Commissioners for £100,000 the ground and buildings

between the foregoing block of land and Imperial Institute Road.

Each of these three land transactions was governed by the restriction of the use of the site to "purposes connected with Science and Art", and in view of this condition the transferences were made at less than half the market value of the ground at the times of sale.

These transfers concluded the major sales of land in the history of the Commission. The net result appears to be that (1) the Government obtained on most favourable terms two great sites of first-rank value; (2) the Commissioners retained under their own control an adequate central area for the development of institutions in furtherance of their aims; and (3) the Commissioners retained a surrounding area available for sale or lease for beneficial occupation by others on terms which would regulate the amenity of the locality and at the same time yield, from sales and ground rents, a satisfactory revenue for disposal by the Commissioners in furthering the objects for which the Comsion was established.

System.

In their Second Report (1852) the Commissioners directed attention to the need for further and more systematic efforts for the promotion of science and art in Great Britain—instruction for its industrial population—facilities for the exchange of results of study and investigation between investigators as well as between these and the public. In their Third Report (1856), they refer to the establishment of "the Department of Science and Art" in 1853, and they record and illustrate the establishment or strengthening of various central and provincial institutions engaged in promoting science, art, and the industries, or in bringing inventions, designs, etc., before the public by museum representation. Truly the seed had been wide-scattered and was burgeoning well. Yet not even to-day do we see the full crop. The prospects, however, are promising.

The Department of Science and Art proved to be an effective pioneer. Active local authorities soon found in the Department a perennial fountain of assistance—trickling at first, but always helpful. To-day the activities it fostered in all parts of the country are fed systematically through the Board of Education and Local Authorities. They gain strength steadily.

In 1852 the Commissioners had refused to distribute cups from the spring of enlightenment. Obviously they preferred to work for the development of a real and liberal national supply system. Being wise, they did not advertise their expectation. The occasion was not opportune nor was the prospect promising. Their work did much to promote the aim; but they could not have imagined that the full development of 'System' would be a matter, not of years, but of generations!

The Prince Consort.

In December 1861 the Prince Consort died. The Commissioners, in their next Report (1867), wrote: "The Address presented by us to Her Majesty on that sad occasion . . . embodies the sense entertained by us of the irreparable loss we are called upon to sustain by the great Prince's removal from our head—a loss the extent of which each day's experience only tends to confirm".

We of the third and fourth generations sympathise most fully. We also rejoice in many and bountiful crops which his vision and the wise administration of his successors have secured.

(*To be continued.*)

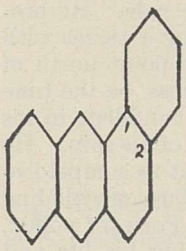
Tar Cancer.

THE fact that workers in the shale industry show a relatively high incidence of cancer led to the discovery that certain tar products which had been exposed to high temperatures could produce cancer when painted on the skin of mice. It was then found at the Cancer Hospital Research Institute that heating a variety of materials, such as acetylene, cholesterol, human skin, muscle, or hair, and yeast, to temperatures of 700°-900° resulted in the production of carcinogenic agents. Attempts were next made to produce similar substances at lower temperatures, and Schroeter, some years ago, found that when aluminium chloride acted upon tetralin (commercial tetrahydronaphthalene) at 30°-40°, a mixture of high-boiling compounds was formed.

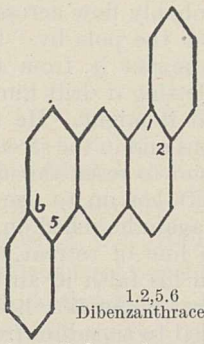
E. L. Kennaway and I. Hieger (*Brit. Med. Jour.*, June 7, 1930; p. 1044) have recently reported that this material is carcinogenic as well as that prepared at 60°-70°; they noticed that the concentration of the aluminium chloride had to be above a certain minimum and that the treatment had to last a certain minimum time for the production of active material. Later observations suggested that the carcinogenic agent might not be produced in effective amount at body temperature, but that its concentration was increased by the heating necessary to distil off the unchanged tetralin. This line of research was, however, temporarily dropped when the authors noticed that this carcinogenic material shows a blue-violet fluorescence, especially intense in a beam of ultra-violet light. The fluorescent light gives a spectrum with three bands at approximately 4000, 4180, and 4400 A.

Examination of a large number of pure hydrocarbons and other substances was then undertaken, but without the discovery of one showing these bands: 1.2 benzanthracene, however, gives three, resembling them in character and position relative to one another, but lying slightly nearer to the invisible region. Addition of aliphatic or aromatic side chains to the benzanthracene molecule shifted the spectrum towards that of Schroeter's mixture, but none of these compounds has yet been found to be carcinogenic. Condensation of another benzene ring with the benzanthracene nucleus

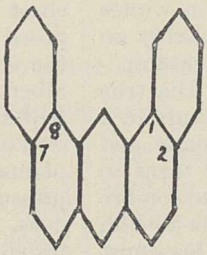
produced some compounds which both showed the three bands (but again shifted towards the invisible region) and were at the same time carcinogenic. The 1.2,7.8 compound was the most potent, but tumours were also produced by compounds of the 1.2,5.6 series.



1.2 Benzanthracene.



1.2,5.6 Dibenzanthracene.



1.2,7.8 Dibenzanthracene.

Twort and Fulton found that chrysene is carcinogenic : its fluorescence spectrum is similar to that of benzanthracene but lies considerably nearer the region of short wave-length.

The spectrum of Schroeter's mixture is given by a number of carcinogenic tars, including those obtained by heating certain animal or vegetable tissues : if acetylene tar is saturated with chlorine the bands are shifted towards the benzanthracene position and the carcinogenic potency at the same time reduced. Certain carcinogenic agents fail to give the bands, whilst a few substances showing them are not carcinogenic. It thus appears that the spectrum is not specific for carcinogenic agents, but the presence of the spectrum without activity may merely indicate that a carcinogenic agent is present but in too low a concentration to affect the skin of a mouse : the fluorescence test is a much more delicate one than the production of cancer in mice. The frequent occurrence of this spectrum may, however, prove useful in the preliminary examination of various substances suspected of carcinogenic effect, and may finally lead to the detection of a pure compound or compounds having this action. When reached, this result may throw light on the origin of cancers developing spontaneously.

Obituary.

Dr. Fridtjof Nansen.

DURING most of his lifetime the whole world has acclaimed Fridtjof Nansen as a man of the first magnitude, and his fame has grown as his years increased. His outstanding figure shines in history by its blending of almost all the elements of human greatness, and probably this is why the press writers of to-day, when setting forth his claims to immortality, have so often been swept away in a flood of panegyric. I knew Nansen for forty-one years, from the time of his first crossing of Greenland, throughout the struggle to launch his *Fram* expedition, and the laborious years spent over the scientific reports on the work it accomplished. I was with him year after year at the meetings of the International Council for the Exploration of the Sea, and at other scientific gatherings in many lands. He was frequent in his correspondence on questions regarding our common interests and the glow of his unfaltering friendship warmed my life. Knowing the difficulties he had to overcome as well as the triumphs he achieved, I trust that it is not presumptuous for me, now that few remain who knew him better, to survey his career from the point of view of a contemporary.

Thirty-four years ago I reviewed in these columns (NATURE, Dec. 31, 1896, vol. 55, p. 201) an English translation of the life of Nansen, which was written when most people believed that he had perished in the Arctic. There is little in that article that I wish to change, and it may still be read as supplementary to this.

Nansen had a great heredity in which the elements of his own personality can be clearly traced. Without going back to the old Viking strain which came out in his magnificent stature and rugged features, we find full proof in the recorded family tree. His great-great-grandfather, born at the end of the sixteenth century, was a Dane, Hans Nansen, who as a lad spent a winter frozen in the ice of the White Sea, as a young man commanded a ship in the Iceland trade and wrote a book on the wonders of the sea, later becoming Burgomaster of Copenhagen, a prominent politician and a fervent patriot. His grandfather, Hans Leierdahl Nansen, nearly a hundred years later, was a Norwegian by settlement, a judge and government official, a keen politician, a man of many words rather than of action, but a patriot of the perfervid type, determined, if Norway must enter into close alliance with Sweden, that there should be no phrase in the treaty of union which could imply any inferiority in the partnership. His father, magniloquently named Baldur Fridtjof Nansen, and an aristocrat on his mother's side, was a quiet, studious man, occupying a responsible position in the legal profession, indifferent to outdoor sport, very strict in his parental oversight, governed in all things by inexorable principles. His mother, on the other hand, was a practical, energetic, strong-minded person who, as a girl, had horrified the prim society of the period by taking up the unmaidenly sport of ski-running, in which she excelled.

Nansen was born on Oct. 10, 1861, in a small country house at Store-Fröen in Aker, near Oslo ; they gave him the name of the hero of an old saga, and never was there an apter christening :

As the acorn wins to a sapling, as the sapling waxeth an oak,
A goodly guard of the forest, and fronting the storm-wind's stroke,
So grew in his beauty Frithiof ; he waxed a man among men ;
In his heart was the love of all things, and his might was the might of ten.

Like his namesake of the northern mists, young Fridtjof grew up in the open, bathed in the ice-cold waters, risked his life a hundred times on fjord and fjeld, and beat all his comrades in every manly sport. When a student his name was noised abroad as the champion ski-runner of Norway, and his holiday excursions over the high fjelds in winter were marvels of endurance. He was probably no better at book learning than most of his contemporaries at the University of Christiania. His true education came from his contact with Nature in a land where the contrasts of scenery, of climate, and of season are at a maximum, serving by turns to sting life into action and to awe thought into sombre introspection. A strong poetic vein came to him from his ancestors: in the midst of his most strenuous exertions he would give expression to emotions that an ordinary athletic Englishman might be tempted to scorn as sentimentality, yet they were part of the man.

At the age of nineteen Nansen decided to take up biology as his life-work. Text-books did not attract him, but research was a mode of learning that made an appeal. To take a real grasp of any truth he had to discover it, or at least to recognise it, for himself. Priority was a question which did not trouble him at any time; in conducting an investigation he was intent on solving a problem which interested him mainly as a difficulty which he had undertaken to overcome.

Nansen's biological researches won for him the curatorship of the Bergen Museum and his Ph.D. degree; they were characterised as promising by the specialists, but they were probably little in advance of the average of post-graduate work. Biology was not the master-passion of Nansen's life; but it set him on his way when, in 1882, on board the sealer *Viking*, in the investigation of the polar fauna he first saw Arctic ice. At the age of twenty-six he seemed to be heading for a comfortable biological chair in a university; but the spirit of his fathers had leaped from the northern waves and pointed to another field of fame.

It is difficult for the present generation to realise the opposition to which Nansen's project of crossing the Greenland inland ice gave rise. Whymper, Nordenskiöld, and Peary had all tried to advance over the ice-cap from the west coast and all had failed. This young man resolved to succeed, first halving the distance to be traversed by starting from the east coast and providing no line of retreat. He wished to go forward, and forward he had to go, for there was no possibility of going back. He was to take a small party, and he devised light gear and special cooking apparatus. The authorities said no one could carry out such a plan; Nansen knew he could, and he did. He had been sure of success from the first and upheld his faith in himself with a firmness that would have struck a stranger as presumptuous obstinacy but for his modest bearing and the disarming sweetness of his smile.

Nansen's natural self-reliance and stubbornness were increased by his success and by the year's lecturing in all parts of Europe which followed. His mind conceived the far more ambitious project of reaching the North Pole. Impressed by the extent and strength of the East Greenland Current and the vast quantity of ice and drift wood which it carried southward between Greenland and Iceland, he studied the problem of its origin and arrived at the conclusion that it must arise near the Siberian coast and probably flow across the pole. He proposed to reach the pole by "taking a ticket with the ice", so he put it, from some point north of Siberia, and letting it drift him across, be the time required what it might. He was confident in his own deductions and in the strength of his ship. He planned her not to resist the ice but to compel ice-pressure to lift her on to the surface of colliding floes. Once again he relied on the Forward policy, providing no line of retreat, staking his life and reputation on his faith in an idea. In the words of his mythical namesake, he might have said to those who tried to turn him from his purpose:

> Now once for all I have chosen; the cost of my choice I know;
> And there lives not the man shall stay me the way that I choose to go.

Like his mythical namesake, too, he had an invincible ship, and a crew of true men, all equals, messing together and working together, and all devoted to their leader. The ship he named *Fram*, which means 'forward', and forward he went, defying all the rules of earlier polar exploration. Again, in the teeth of all expert advice and every traditional dictate of prudence, Nansen achieved success, though he did not reach the pole.

Nansen's fame was established, but there was no change in the man. He could not be any surer of himself or any more determined in the assertion of his own opinion than before; but he stood the storm of applause, unperturbed by the medals and the orders, the banquets and the flatteries, the publicity and the fortune which resulted. I have known almost all the great explorers of my time, and Nansen was the only one on whom an overwhelming success left no jetsam of deterioration. His manner remained as modest, his smile as winning as before. Not that he attained to any superhuman perfection. He still liked to draw the public eye, though he no longer displayed his fine figure in the tight-fitting athletic costume which attracted so much attention in the streets of the capitals after the Greenland expedition. He had not foreseen the depth of the Arctic Sea, and his oceanographical apparatus was inadequate. In his great march on the ice he had let his watch run down and lost his longitude; but from a boy he had felt himself under the influence of a lucky star and he had won through by sheer force of body and mind.

Physical oceanography took the first place thenceforth in Nansen's researches, and for several years he worked on the "Reports" of the *Fram* expedition, striving to make up for inadequate equipment by getting the very utmost out of the cleverly devised emergency methods used on the great drift. The scientific results were certainly of far-reaching value, but the chief glory of the *Fram* expedition was that it gave the death-blow to the

(*Continued on p.* 943.)

Supplement to NATURE

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Recent Discoveries of Fossil Man.*

By Sir ARTHUR KEITH, F.R.S.

GARDARENE MAN.

A REMARKABLE discovery was recently announced by Dr. F. C. C. Hansen, professor of anatomy in the University of Copenhagen. Prof. Hansen is the leading authority on all that relates to the anthropology of Greenland, his monograph on the craniology of the Eskimo being the standard treatise on this subject. Recently he received from Greenland a series of human bones discovered during the excavation of a twelfth century graveyard which had been attached to the cathedral church of Gardar (Igaliko), south-west Greenland. In one grave the remains of a bishop were found with crosier by his side and gold ring on his finger; the other graves contained the bones of Norsemen (Vikings) who settled on the west coast of Greenland, just north of the southern end, early in the eleventh century. Amongst these bones Prof. Hansen discovered a lower human jaw and a large part of a human skull manifesting characters more primitive and more massive than even those of the Rhodesian fossil skull. These peculiar bones were not fossilised; they were in the same condition as those of the twelfth century Norsemen.

There is a possibility, seeing how prehistoric the Eskimo are in feature and ways of living, that some belated representative of fossil man—okapi-like—might have survived in Greenland until Norse times and his remains might have thus come to be buried in an early Christian cemetery. Having seen only imperfect accounts of what had been found, I wrote to Prof. Hansen, who, although he has not published the results of his investigation, has with great liberality sent me drawings and photographs and a full description of the remarkable specimens which have come to Copenhagen. That the bones represent an extraordinary and undescribed type of man there cannot be a doubt. The lower jaw is more massive than has ever been found in a human face—yet it is regularly formed and of enormous strength. That part of the base of the skull to which the neck is attached has expanded into great plate-like buttresses of bone. The hinder (occipital) part of the skull is sharply bent as in the Java skull, the newly discovered Peking skull, and in the Rhodesian skull. The temporal muscles of mastication have expanded upwards on to the top of the head until they almost meet—as in the female gorilla. Although the forehead has been partly lost, it is clear that it was low and receding, and that the skull must have been of enormous length (235 mm.)—nearly an inch longer than the longest fossil human skull known to us. But, like early fossil skulls, it was very low in the roof—the vault rising not more than 108 mm. above the ear passages. The face was two inches longer than the face of the average Norseman. The walls of the skull were not unduly thickened, but certain appearances in the finer structure of the bone suggest that growth was not quite normal.

To this old but undescribed and hitherto unrecognised type of humanity, Prof. Hansen has given the name *Homo gardarensis*. The problem anatomists have to solve is: How did *Homo gardarensis* come to be buried in an early Christian Norse graveyard in Greenland? Prof. Hansen will have nothing to do with the 'okapi' theory—he refuses to suppose that a prehistoric type of humanity could have survived in Greenland; there is no trace of Eskimo in Gardarene man. The explanation he offers is this. Certain of the Norse graves contained bones of big-headed, very muscular men. He thinks that in an isolated Norse colony, where families of exceptional strength of body had been segregated, there had been a degree of inbreeding which called forth in some child the latent inheritance of antiquity, that *Homo gardarensis* may therefore be looked upon as an atavism—the reproduction of a type of man long since extinct.

In the Museum of the Royal College of Surgeons there is a series of skulls which throws light on the nature of *Homo gardarensis*. Twenty years ago I became interested in that peculiar disorder of growth known as acromegaly—a disorder due to a derangement in the organs of internal secretion, the pituitary gland being the one chiefly at fault. The skulls of men who suffer from acromegaly, assume—in a bizarre form—all the characteristics of the

* Abridged from six lectures given in the Royal College of Surgeons of England on May 5, 7, 9, 12, 14, 16, 1930.

skulls of ancient fossil man—particularly Neanderthal and Rhodesian characters. Giants, however, particularly in the first stage of this disorder, assume such cranial characters in a much more regular way—all parts of the jaws, face, and skull proceeding to a harmonious excess of growth. Certainly the specimens described by Prof. Hansen exceed in size and regularity the giant specimens in the Royal College of Surgeons, but they are manifestations of excessive growth of the same kind. *Home gardarensis* must have been the subject of a disorder of growth—the kind of disorder which causes giantism in man, but whereas in most giants growth soon becomes irregular, in *Homo gardarensis* it remained regular.

When we have classified this strange descendant of a Viking with giants we have not explained all. The growth mechanism which is in each of us is a heritage from fossil man. It is therefore quite possible, as Prof. Hansen maintains, that *Homo gardarensis*, although not found in a fossil state, may reproduce a stage of man's evolution which may yet be actually discovered in a fossil state. The Gardarene skull in some points resembles that of giant O'Brien in the Museum of the Royal College of Surgeons, in others the skull of the Bristol giant—Patrick Cotter, described by Prof. E. Fawcett in the *Journal of the Royal Anthropological Institute*, Vol. N.S. 12, p. 196 ; 1909).

Colonisation of Europe by Neanthropic Man.

The pioneers who took possession of Europe on behalf of the white (Caucasian) race of mankind began to arrive at a certain phase of the last period of glaciation. There is still a wide difference of opinion amongst experts as to the number of times northern and central Europe became entombed beneath an ice-sheet during the Pleistocene period, but nearly all are agreed that the last ice age was divisible into three phases. There was an opening phase marked by great falls of snow and a southward spread of the ice-sheet ; there was a middle phase, very cold but comparatively dry when central Europe took on the aspect of the steppes of Russia ; then came the third or final phase, one of great snowfall and severe cold. This triple division of the last ice period, so important to the student of fossil man, seems to find an explanation in a theory recently formulated by Dr. G. C. Simpson,[1] who points out that as the maximum phase of cold is reached snow does not continue to fall more, but less abundantly, for two reasons. The atmosphere at the equator and poles, becoming colder, can take up and carry a much smaller burden of moisture ; the air currents which carry moisture from equator to poles fail because the difference in temperature between equator and poles becomes less. The optimum conditions for snowfall and glaciation occur at the opening and closing phases of an ice age. It was at or near the beginning of the middle or cold and dry phase of the last ice age that the white race of mankind began to take possession of Europe.

Our evidence is now sufficiently extensive to assure us that until the coming of the white pioneers —the Cromagnons and Předmostians—Europe had been inhabited by, and in the sole possession of, men totally unlike any race now living—men of the Neanderthal type. The increasing severity of climatic conditions in the opening phase of the ice age may have pushed Neanderthal man towards extinction, but the climatic change cannot be held accountable for his complete disappearance, for many lived in Spain, southern France, and Italy beyond the range of arctic conditions. When we look at the forerunners of our kind, the disappearance of Neanderthal man can be understood.

Until recently our knowledge of the early colonists of Europe was founded on discoveries made in the caves of central and southern France. That was because French archæologists had moved ahead of their brethren in other countries. It was thus we came to know of the tall, big-headed, strong Cromagnon people ; they were cavemen. Even in France, however, people at this early period camped in the open ; at Solutré a great field station has been explored ; the fossil remains of the people have been discovered there, and their hunting mode of life determined. Recently Moravia—now a province of Czechoslovakia—has begun to rival France in the contributions she is making to our knowledge of the early white or Caucasian settlers. In the middle—or cold and dry—phase of the ice age, large parts of Moravia became gradually covered over by drifts of loess—a fine earth. The loess drifted over the open camps of the mammoth hunters, burying their hearths, refuse-heaps, utensils, weapons, ornaments, and works of art where they are now preserved deeply buried under many feet of loess. Dr. D. K. Absolon, curator of the Government Museum at Brünn (Brno), has recently explored by trial shafts such an ancient camp near Wisternitz (Vestonice), and finds that it extends over hundreds of acres. Brünn itself is built over several such stations ; the grave of an old mammoth hunter was found deep beneath one of its main streets. Two years ago, when the foundations of a house were being dug in the suburb,

the grave of a woman of the same early period was opened.

The most famous, however, of the open stations in Moravia lies at Předmost on the eastern side of the province. Although this station has been known for fifty years, its extent is only now being revealed along the sides of trenches cut in the loess by a brickmaking company. It was in the loess at Předmost that the late Prof. Maska discovered the tomb of the mammoth hunters, in which lay the remains of twenty individuals—men, women, and children—the earliest family or common tomb known. Although this discovery was made more than thirty years ago, it is only now that anthropologists have had an opportunity of determining the racial characters of the people buried in the tomb. For this opportunity they are indebted to Dr. Absolon, who has distributed exact casts, not only of the skulls of the mammoth hunters but also 'brain-casts' taken from the interior of the skulls. The brains of the mammoth hunters, even when measured on our modern standard for Europeans, were large and richly convoluted. These Předmostians were not tall like the Cromagnons of southern France, but short and stout, and like the Cromagnons they were big-headed, strong-jawed, and of muscular build. The physical differences which distinguish the Předmostians from the Cromagnons are of a local nature—such as distinguish the tall Gallowegian Scots from the shorter people of Kent.

Anthropologists have been strangely chary in applying a racial label to those early invaders of Europe—the Cromagnons and Předmostians. When we look round the world—ancient as well as modern—for their nearest of kin, it is not in Africa, Australia, or in further Asia that we find them. In all their characters they are Europeans or proto-Europeans. They differ from modern Europeans chiefly in size of jaw and the robust development of face, and of thigh bone. Dr. Absolon believes the Předmostians must have come from Asia; their culture appears to have been derived from there. It is likely we shall also trace the Cromagnons to Asia, but there are many who believe that the weight of evidence favours North Africa as their homeland. The Cromagnon people became modified in Europe, but their cradle of evolution lies elsewhere. Since the time these settlers brought the Aurignacian culture to Europe there have been many invasions, but it is quite possible that Cromagnon and Předmost blood may flow in the veins of men and women still alive in Europe.

When we follow, by means of dated burials, the history of Europeans through the third phase of the last ice age—we find food for reflection. In the rigours of the last phase tallness disappeared; but the people remained muscular and big-headed. They lived under such conditions as the modern Eskimo live, and their jaws and certain other parts of the skull took on an Eskimo strength of development. Under this mask, however, in nose, forehead, chin, and face can be seen the essential marks of the Caucasian. Later still, when modern climatic conditions were dawning, which on the reliable data provided by Swedish geologists, we may suppose to have happened 10,000 or 12,000 years ago, the physique of Europeans became more reduced. There were, so far as we know, no tall people in Europe then; big heads and strong jaws had become uncommon. The people became small in body with slender bones, but whether these Europeans, which saw the dawn of our present climatic conditions, were the degenerate descendants of the great pioneers—which seems to me not unlikely—or were new invaders, we cannot yet say. It is just when glacial conditions were giving way to more temperate times that our knowledge of our European ancestors becomes most deficient.

The Ancient Inhabitants of Palestine.

An account may now be given of the men and women whose fossil remains have been discovered in cave-deposits of Palestine. In 1925 the British School of Archæology opened a new chapter in our knowledge of the ancient inhabitants of the East. In that year Mr. Turville Petre, while excavating a cave on the western shores of Lake Galilee, on behalf of the School, discovered a deep and intact stratum containing objects of that very ancient stone culture—the Mousterian—which in Europe is always associated with Neanderthal man. Mr. Turville Petre found in this stratum part of a human skull which was Neanderthal in type, thus proving that Palestine, at a remote period, had been inhabited by men of the Neanderthal type, and that, as in Europe, their culture was Mousterian. In a neighbouring Galilean cave he found stone cultures which correspond to those which succeed the Mousterian in Europe, but as no human remains were present it was impossible for him to determine whether in Palestine as in Europe there had been a sudden replacement of Neanderthalians by men of the modern (neanthropic) type.

Three years later (1928) this blank in our knowledge was made good by Miss Dorothy Garrod. On behalf of the British School of Archæology she began the exploration of a cave situated at Shukbah

on the western slopes of the Judæan hills, about midway between Joppa and Jerusalem. In the deepest part of the cave she found—as Mr. Turville Petre had done in the Galilean cave—a Mousterian stratum, and fortunately this stratum contained heavily fossilised fragments of human bones. These were submitted to me, and I was able to confirm their identification as parts of Neanderthal man. The overlying strata contained a stone culture known as upper or late Capsian, a culture which corresponds with the later Aurignacian of Europe. In the Capsian deposits were remains which represented about two score of people of the modern or neanthropic type—men, women, and children. Thus was proved that in Palestine as in Europe there was, in later Pleistocene times, a replacement of both race and culture.

In the spring of 1929 it became necessary to explore a large cave in the western flank of Mount Carmel, as it was then proposed to open a quarry at its site. The Director of Antiquities for the Government of Palestine made preliminary excavations and was rewarded by rich archæological discoveries. He requested the British School of Archæology to undertake the exploration of the Carmelite cave—one of very great size. Miss Garrod, although she had not completed the exploration of Shukbah, took charge on behalf of the School, and pitched her camp on the plain of Sharon just under the western flank of Mount Carmel. In her hands the cave is proving to be a vast archæological treasure-house. Palæolithic implements occur in thousands; there are carvings and other works of primitive art. There is a succession of well-marked strata indicating that the cave was inhabited by man at various periods of the Pleistocene period. The deepest stratum is Mousterian; that as yet remains unexplored. Over it came strata containing a succession of Aurignacian cultures (middle Aurignacian and later). Then follow deposits containing cultures which mark the end of the Palæolithic period. Nowhere in the strata was there any trace of pottery, or any suggestion of agriculture. The inhabitants lived on the natural produce of valley, plain, and shore—which is but three miles distant.

In this Carmelite cave almost every stratum contained human fossil bones—sometimes mere fragments, at other times almost complete skeletons. A full report on the human remains cannot be prepared for the School of Archæology until Miss Garrod has completed her labours at Mount Carmel and Shukbah. A preliminary examination, however, makes quite clear that these Aurignacian inhabitants of Palestine were neither Jews nor Arabs. They were a small-sized people, with short faces, long heads, very different from the tall, strong Cromagnon people of France—their contemporaries. Their faces were short and their noses were low-bridged and flat, with a distinct suggestion of African origin in them. Indeed their derivation from North Africa—or an affinity with the people who occupied Algiers and Tunis in Capsian times—must be considered. French archæologists have observed that the ancient Capsian people of North Africa had the custom of extracting one or both of the upper central incisor teeth in youth. The cave people of Palestine had the same practice—one which is continued to-day by many negro tribes of Africa. Yet the early Palestinians were in no sense negroes; the proportions of their limbs are European, not negroid. Nor in shape of skull are they negroid—only in the conformation of nose and face. Nor does there seem to have been with the succession of cultures any decided change in race; the same small people appear to persist throughout the later cave periods.

In the competition to uncover the beginnings of modern civilisation, Palestine has been outstripped by surrounding countries—Egypt, Mesopotamia, and Crete. But where their records leave off those of Palestine begin and carry human history into a very remote past. In Biblical times Palestine was the pawn of her mighty neighbours. Miss Garrod's researches reveal her, even in Pleistocene times, as the scene of contending northern and southern forms of culture.

The Prehistoric Races of Africa.

At the present time there are being exhibited in the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, the fossilised remains of three ancient types of Africans. One of these is the complete skeleton of a man found in the deepest stratum of a cave in the Rift Valley, Kenya Colony, by the East African Archæological Expedition, under the leadership of Mr. L. S. B. Leakey. Not only are the stone implements shaped by this ancient Kenyan race similar to those wrought by the earliest Cromagnon people of Europe, but there are certain points of resemblance to be seen in the fossil skeleton from the Rift Valley and the tall Cromagnon people of prehistoric France. The second specimen on exhibition is an intact skull, in a perfectly fossilised state, which represents a remarkable stage in the evolution of the Bushmen of South Africa. For the opportunity of exhibiting this skull in England for the benefit

of students of ancient man the College of Surgeons is indebted to its discoverer, Mr. B. Peers of South Africa. In everyday life Mr. Peers is a railway porter, but in his leisure time he is a highly skilled cave-explorer. Recently, assisted by his son, Mr. Peers completed the excavation of a vast cave near Fish Hoek, fifteen miles south of Cape Town; at a depth of ten feet in an undisturbed stratum containing a Palæolithic culture, known to South African archæologists as 'Still Bay', the fossilised skeleton of Fish Hoek man was found. The third exhibit, also a fossil skull, was sent home on loan by its discoverer—Prof. M. R. Drennan of the University of Cape Town. It represents an 'Australoid' type of man which appeared early in South Africa.[2]

Archæologists are now searching all parts of the world to ascertain the country which gave early Europe her Cromagnon pioneers and the stone culture they brought with them—the Aurignacian. The discoveries made by the East African expedition under Mr. Leakey had an important bearing on this search. The culture of the ancient Kenyans—men of the Elmenteita type—had so many points of correspondence with that of the Cromagnon people of France that one must presume extensive borrowings or a derivation from a common source. In Cromagnon times the Sahara was not a desert, and Mr. Leakey favours the idea that North Africa may have been the homeland we are in search of. There is a certain resemblance between the Cromagnon and ancient Kenyan types. Both were tall, with long heads and big brains. But in the fossil type of Kenya we recognise distinctly African traits in the proportions of limbs and in the structural details of face and head.

The ancient Kenyans were certainly not negroes, but in my opinion represent an early Hamitic type.* If we suppose these people to have come from northern Africa, then we must also presume that there has been, since their arrival in Kenya, an enormous expansion of Negro peoples, for all the lands between Kenya and Khartoum are occupied by Negro tribes. On the other hand, if we follow the trail of Hamitic man as seen in the modern races of Africa, we are guided towards the Straits of Bab-el-Mandeb and Arabia. In Aurignacian times, Arabia and the deserts of south-west Asia were fertile, and it is to these parts of Asia that I looked for the discovery of a source from which both Europe and Africa derived a community of culture and of physical traits.

* Mr. Leakey dissents from the opinion expressed here. He regards Elmenteita man as racially akin to the Combe Capelle and Grimaldi people of Europe.

One of the chief results which have issued from Mr. Leakey's researches in Kenya Colony is to give archæologists a time scale for measuring the prehistoric events of Africa. His evidence favours the belief—if it does not prove it—that the Elmenteitans of Kenya were the contemporaries of the earliest Cromagnons of France. His time scale has given us a clue to the date of other fossil human remains which have been discovered in Africa. In 1913 a skeleton was found by Dr. Reck at Oldoway, in what is now Tanganyika Territory, embedded in a pleistocene deposit. There can be no doubt that the Oldoway man is of the same type as Mr. Leakey's ancient Kenyans and belongs to the same period of time. Last year the fossil skeleton of a man, described by Dr. R. Broom,[3] was discovered within a Pleistocene deposit in the northern Transvaal. It is probable that the Australoid type now exhibited and described by Prof. Drennan may prove to be an offshoot of the same stock. The Bantu peoples of Africa have spread into South Africa in comparatively recent centuries; there seems to have been a similar migration of a proto-Hamitic people in Pleistocene times.

Our search into the prehistory of man is bringing to light strange and unexpected things. One of these is the great development of body and brain in the early Palæolithic hunters—the ancestors of the men who brought in the last stone age and the beginnings of our modern civilisation. At first sight one is apt to ascribe our modern falling away in size of jaw and brain to the effects of city civilisation. That this is not the whole cause is proved by Mr. Peers's discovery of the ancestor of the Bushmen of South Africa. Modern Bushmen still retain the wild, hunting mode of living. Yet their jaws and faces have undergone the same reduction as are seen when we compare the skulls of modern Europeans with those of the ancient Cromagnons. The ancestral Bushmen from the Fish Hoek cave had, like the Cromagnon people, an exceptionally large brain—fifteen per cent more than is usual in modern Bushmen. The proportion between the face and the brain-containing part of the head in the ancestral Bushman was that which is seen in modern children at the age of eight or ten years—where the face is small in proportion to the size of head. This is so in all dwarf races of mankind—to which racial category Bushmen belong. Prof. Drennan, who has published a preliminary account of the Fish Hoek skull, applies to its explanation a law which is gaining assent from anthropologists; namely, that the retention of infantile and youthful traits plays a part in the

evolution of new human races—particularly of the dwarf races of mankind. In their structural make-up Bushmen show a strange mixture of prehistoric and ultra-modern traits.

The Significance of Peking Man.

European anatomists are now in a position to appraise the significance of the fossil remains of man discovered in cave-deposits at Chou Kou Tien, 37 miles to the south-west of Peking. Prof. Davidson Black had placed at their disposal full details of his discoveries, and an examination of the evidence submitted leaves no doubt that China has made a contribution of the highest importance to our knowledge of the evolution of men. The discovery has a threefold interest: first because of the part of the world in which it has been made. Of the prehistoric human types which inhabited the vast continent of Asia we knew nothing until now. Secondly, the discovery is important because it gives us the evolutionary stage reached by the ancient Asiatics at a time which is critical in the evolution of humanity—the beginning of the Pleistocene period, the geological period which preceded the dawn of our modern world. Former finds had made us acquainted with three beings who belong to this early period—the Java man (*Pithecanthropus*), Piltdown man (*Eoanthropus*), and Heidelberg man (*Palæoanthropus*). Now we have a fourth—Peking man (*Sinanthropus*)—from the distant part of another continent. The closest relationship of this new arrival lies with Java man, but it has also resemblances to the pre-Neanderthal type of Europe represented by Heidelberg man.

The third aspect of this new discovery is the scientific manner in which it has been carried out. The most up-to-date and exact methods have been applied. It has been made by a highly skilled band of men enrolled from various nationalities. The anatomist, Prof. Davidson Black, is a Canadian and a distinguished representative of the British school of anatomy; the geologist and discoverer of the site is Dr. J. G. Andersson, a Swede; the archæologist, Father Teilhard, is French; the director of excavations, Mr. W. C. Pei, is a Chinaman—a member of the Geological Survey of China. A system of scientific co-operation has given full, precise, and reliable facts concerning the nature of Peking man and of the times in which he lived.

When human remains are found in a natural deposit, disputes are apt to arise as to its geological age. It is therefore fortunate that Dr. Anderson had dated the geological deposits at Chou Kou Tien before the first trace of man was found, and although at first he was inclined to regard them of late Pliocene age, yet a fuller study of the animal fossils, particularly the fact that the three-toed horse had disappeared and been replaced by the one-toed form, led him to assign the deposits—laid down in limestone caves and fissures at Chou Kou Tien—to an early part of the Pleistocene period—a conclusion confirmed by all later observations. Thus we can safely regard Peking man—known to the scientific world as *Sinanthropus pekinensis*—as representing the evolutionary stage reached by the inhabitants of the eastern part of the Old World at the beginning of the Pleistocene period. In the cave strata which yielded the human remains no hearths were traced, no sign of fire seen, and no shaped stone or bone which could be regarded as a tool found. It would be unsafe to presume, on this negative evidence, that *Sinanthropus* was ignorant of fire and had not discovered the use of tools.

The importance of an archæological discovery can be estimated by the extent to which it causes a re-orientation of previous knowledge. *Sinanthropus* can be fitted into the genealogical trees of man's descent now in common use. He sprung from the main human stem near the branches which gave us Java man on one hand and Neanderthal man on the other. We have, however, to alter or reconsider our ideas concerning the rate at which the human brain has evolved, or alter our estimate of the duration of the Pleistocene period. In Java man the brain was just reaching the threshold of a human standard. We regard 950 c.c. as the lowest possible limit of brain size compatible with the simplest manifestations of human mental life; the Java man was just reaching that size of brain, at the end of the Pliocene or beginning of the Pleistocene period. In later Pleistocene times we find large-brained human beings—both of the Neanderthal and of the modern types of man.

If we regard the Pleistocene period as having a duration of only 250,000 years, we must presume that the evolution of the human brain has been unexpectedly rapid to convert the Java brain into that of later Pleistocene man. Seeing how complex and intricate an organ the human brain is, such a transformation has seemed impossible and hence Java man has come to be regarded not as an ancestral stage, but as end shoot—a survival of an earlier small-brained period. Now, however, comes the evidence from China. In brain size Peking man resembles Java man—only a little

larger—just within the human minimum standard. As Prof. Davidson Black points out, there is definite evidence on the outside of the skull to make us certain that the brain had moved a stage in a more humanward direction than had that of the Java man. Even if we take the highest estimates for the Pleistocene period—a duration of 1½ million years—the changes which would convert the brain of *Sinanthropus* into that of the La Chapelle man would have to be of unexpected rapidity.

There is, however, another possibility. The men of Java and China may not have represented the highest stage reached in human brain development in early Pleistocene times; elsewhere in the world there might have been a higher form of humanity. Peking man lived at the eastern end of the Old World; his contemporary—Piltdown man—lived at the western end of it. Piltdown man, in spite of his ape-like canine teeth and his simian chin, makes an infinitely closer approach to the modern type of man than does Peking man. The latter has the flattened head which we knew of only in Java man; he has the great bony beam across his forehead which we meet with in Neanderthal man, and many other traits which give him a claim, as Prof. Davidson Black has said, to be considered as a possible ancestor of the Neanderthal races. The chin of a fossil child (*Sinanthropus*) shows a stage in the transformation of a simian into a human chin. The Peking teeth have revealed a mixture of characters—some very ancient and others almost ultra-modern. On the other hand, Piltdown man has none of the Neanderthalian or Javanese traits; the conformation of his skull bones and of his head herald features of modern man. All along I have maintained that Piltdown man was not small-brained, nor is the organisation of his brain of a lowly type. Even the lowest estimates of his brain capacity—1200 c.c.—place him well within the modern category of brain size. On the evidence as it stands, England may justly claim to have been leading the world in early Pleistocene times. Piltdown man fashioned and used elaborate tools. The evidence collected by Mr. Reid Moir in the Pliocene deposits of East Anglia also favour England's claim to priority in the evolution of higher humanity.

Preglacial Europeans.

An account has already been given of the type of man who inhabited Europe before the onset of the last glacial age. The fossil remains of one being of this distant period was discovered last year almost at the gates of Rome. The Aniene, a stream which joins the Tiber just before that river enters modern Rome, filled its valley in Pleistocene times with deposits, which are made up of sands, clays, and also calcareous ingredients. In these deposits are entombed the fossil bones of elephant, rhinoceros, hippopotamus, and horse—of kinds which lived in Italy in the temperate times which preceded the last great period of glaciation. In the Aniene deposits are found ancient types of stone implements. Six Mousterian stations have been mapped out within 10 miles of Rome, and although it was suspected they were the work of Neanderthal man, not a bone of that fossil type had been found in Italy until May 1929. In that month a labourer digging in a gravel pit in the lower valley of the Aniene, and working at a stratum which lies 20 feet below the present surface level, uncovered a calcareous mass in which was embedded a human skull.

Prof. Sergio Sergi, director of the Anthropological Institute of the University of Rome, has published a preliminary account of the skull and finds that it is altogether different from that of modern man and is of the Neanderthal type.[4] From the photographs of the skull—still partly embedded in its hard matrix—one can see that it is almost a duplicate of the Gibraltar skull discovered in 1848. Like the Gibraltar skull, the specimen now discovered in suburban Rome—the Aniene skull—is that of a woman; both are alike in being small-brained—less than 1200 c.c.—the smallest headed of all known fossil skulls of the Neanderthal type. Both have the same long gorilline faces, capacious noses, and strong bony torus above the eye-sockets.

The Aniene skull is of the same age as the stratum in which it was entombed, and the geological evidence definitely assigns the deposition of the stratum to the long temperate period which preceded the last glaciation. Thus Italian anthropologists have proved that in their country, as in France, the Mousterian culture represents the handiwork of Neanderthal man, and that before the last ice age the valley of the Tiber, the site of Rome—and in all likelihood the whole of Italy—was inhabited by human beings of the Neanderthal species. The earliest arrivals in Italy of Neanthropic or modern type of man have not yet been found.

More instructive still are the German discoveries made in the valley of the Ilm, just above Weimar—the home of Goethe. The ancient valley of the Ilm had become filled by deposits, but in a manner quite different from that which produced the Aniene formations. The ancient valley of the Ilm had

steep cliff-like sides and a flat meadow-covered floor. From the sides of the valley issued springs charged with calcareous salts which were slowly deposited as the issuing streams flowed across the flat lands. Thus were slowly laid down a series of strata which gradually filled the valley—in some places to a depth of 60 feet. The series of strata finish off in the glacial period; they began to form early in the previous interglacial period.

These Pleistocene deposits—or rocks—are now worked for building and other purposes; several quarries have been opened in the vicinity of Weimar—at Taubach and at Ehringsdorf. The deeper strata, laid down in the temperate period, have yielded many fossil bones of extinct animals, traces of hearths and stone implements of a crude pre-Mousterian kind of workmanship. So early as 1895 two teeth were found—at first attributed to an extinct anthropoid ape—but now known to be human. In 1914 a lower human jaw was found in the deepest fossiliferous stratum, and then in 1916 that of a child. Later, in the autumn of 1925—just before the International Association of Palæontologists visited the pit at Ehringsdorf—a block of rock was blasted from the fossiliferous stratum—at a depth in the quarry of 54 feet—on which was exposed part of a human skull. The work of disentangling the skull and its reconstruction proved laborious, so that it was not until late in 1928 that a description of it was published—by Prof. F. Weidenreich of the University of Heidelberg.[5] The skull represents a preglacial inhabitant of Germany. The skull—that of a young person—is most capacious, and although possessing the hall-marks of the Neanderthal species, yet differs in several important respects from the later representatives of that extinct race. The front part of the skull was not low, but had a high vault. The Ehringsdorf jaws, too, show certain primitive features. Most remarkable of all is the clear evidence that severe wounds had been inflicted on the forehead of the Ehringsdorf person while the skull was still in a fresh condition. The oldest known Neanderthal skull has the marks of Cain on it! Prof. Weidenreich suspects the ancient Ehringsdorf people of cannibalism.

The discoveries made in the valleys of the Aniene and Ilm give us a glimpse of the people who lived in Europe during the last interglacial period; they were of the Neanderthal type. When this type first appeared in Europe is an open problem; Heidelberg man, who must be attributed to a more remote period, foreshadows the features of Neanderthal man. While these discoveries have extended our knowledge of the earlier phases of Neanderthal man, others, particularly that made by Miss Dorothy Garrod at Gibraltar (1925–27), are equally welcome because they throw light on his terminal period. The boy whose fossil skull Miss Garrod found in the deposits of a rock-shelter on the north front of Gibraltar, although only five years of age, was particularly large brained; if he had lived and his brain had grown at the same rate as in a modern boy, it would have been larger than that of the most capacious Neanderthal skull known. The Neanderthal race did not perish for lack of brains.

One other important discovery of the fossil remains of man has been made in recent years—one which carries the distribution of the race as far east as the Crimea. At a Mousterian site, some fifty miles to the north-east of Sebastopol, Dr. Bontch-Osmolooski, Conservator of the Russian Museum, Leningrad, uncovered a fossil skeleton of Neanderthal man. A full account of this discovery has not yet been published, but the remains have been examined by Prof. Boule of Paris—the leading authority on such matters—and he has confirmed their Neanderthal nature. On the other hand, the fossil skeleton unearthed at Podkoumak—north of the Caucasus and to the west of the Caspian—although claimed by its discoverer as being those of Neanderthal man, are certainly not so. The jaws and teeth are marked by all the traits of modern man.[6]

The present state of our knowledge regarding Neanderthal man is this: His remains have been found from Weimar in the north to Malta in the south, from Jersey in the west to the Crimea and Palestine in the east. There were local breeds or races. In point of time, some of the remains go back to an early phase in the last interglacial period; others are attributed to the first phase of the last glaciation. There is evidence that for a long part of the Pleistocene period all the inhabitants of Europe were members of this peculiar Neanderthal race. Did they become transformed into modern man or did the race die completely out? In his Huxley Lecture (1928) Dr. Aleš Hrdlička put forward the case for transformation, and some of his arguments have still to be met. It seems to me more likely that Neanderthal man and modern man stand to each other not as father and son but as cousins. No skull has ever been found which in my opinion can be regarded as transitional or as showing a mixture of characters due to hybridisation of Neanderthal man with modern man. No trace of Neanderthal man has been found in any deposit later than those which are marked by the Mousterian culture. The termination of the race, in my opinion, was clean-cut—such as we meet with when one race rapidly replaces another. Where the replacing races came from—the Cromagnons and the Předmostians—certainly remains an unsolved problem, but such evidence as there is seems to trace the first arrivals of Neanthropic man in Europe from Asia rather than from Africa.

[1] NATURE, Dec. 28, 1929, p. 988.
[2] An account of this skull, given by Prof. Drennan, appears in the *Jour. Roy. Anthrop. Instit.*, vol. 59, p. 417; 1929.
[3] NATURE, Mar. 16, 1929, p. 415.
[4] "La scoperta di un cranio del tipo Neandertal presso Roma." *Rivista di Antropologia*, vol. 28, p. 3; 1929.
[5] *Der Schädelfund von Weimar-Ehringsdorf*, Jena, 1928.
[6] *Russian Anthrop. Jour.*, vol. 12, p. 92; 1922; *ibid.*, vol. 16, p. 99; 1926.

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old style of polar exploring in naval vessels under officers ordered to carry out a plan devised by others. Since the *Fram*, the best polar work has been done by small parties of trained and well-equipped men under a leader following out his own plans by his own methods. It is doubtful, as the *Karluk* and the *Maud* have shown, whether Nansen's theory of the ice-drift on the Polar Sea is correct; but it was the faith of the man that made him great, not the particular object of his belief.

With the present century, Nansen began a series of oceanographical expeditions in the research steamers of the Norwegian Government and sometimes in his own yacht, during which he attacked special problems of oceanic circulation. He took a leading part in the foundation of the International Council for the Study of the Sea in 1900 in co-operation with Sir John Murray. When the Council was established, Nansen stood out for having the central laboratory in Norway, and it was sometimes no easy matter to secure smooth working when his views differed sharply from those of other delegates. He was always so absolutely certain of the correctness of his own opinions that at times he did rather less than justice to his opponents, but even when argument only stiffened his opposition an appeal to his good nature often brought about a conciliatory compromise.

There was in Nansen a singularly engaging *naïveté*, an example of which impressed me so greatly that the spot in Camden Road where he said it remains photographed on my mind. "You know," he said, "people say that I am very difficult to get on with; it's quite a mistake; only give me my own way and I'm the easiest fellow in the world to get on with."

While keeping the Norwegian share to the front at the Council meetings Nansen was doing his utmost, in co-operation with Helland-Hansen and Hjort, to establish Norwegian supremacy in oceanographical research, and extremely important advances have been made by them in the construction and use of apparatus and in the interpretation of the observations bearing on the circulation of the Norwegian Sea and the North Atlantic as a whole.

The political aspirations of his grandfather were rekindled in Nansen's mind when the question of separate consular representation for Norway threatened the union with Sweden, and had personal ambition been a leading motive in him his popularity was such that he could easily have made himself a dictator or a president. But he was ambitious only to secure a separate standing for his country, and the peaceful revolution which gave Norway a king of its own was largely Nansen's work. He would not enter into contentious politics at home, but took a pride in being the first Norwegian Minister to the Court of St. James's, a post he accepted from a sense of duty to his own people, and, despite his appreciation of the personal friendship of King Edward, he resigned with relief as soon as he felt that the new kingdom was fairly on its feet. He never cared for ceremony or formality of any kind, and he went back quietly to his professorship of oceanography and to the joy of research in the open sea.

Nansen was attracted to the earliest history of the Arctic Seas and sought to link the Vinland of the Sagas with the Fortunate Isles of classic legend, finding satisfaction for the weird and wistful cravings of his mind in blurred legends which he strove, with only partial success, to elucidate in his historical work "In Northern Mists".

For a second time Nansen passed through the Kara Sea, and in a mission for the Russian Government travelled the length and breadth of Siberia in order to report on its resources. Then came the War, and the plight of Norway as a helpless neutral, with its shipping paralysed, brought him back to the service of his country as president of the Norwegian Union of Defence. In 1917 he went to America and secured by his personal influence an arrangement between Norway and the United States that saved his country from economic strangulation. When the War was over, he became one of Norway's representatives on the League of Nations, and all his greatness of heart and mind was thrown into the herculean task of repatriating prisoners of war, many of whom were lost in Russia, saving the remnants of Armenian communities from extermination, organising food supplies for the starving millions of eastern Europe, and using his unrivalled personal popularity as an instrument for fighting the worst evils arising from the War. The Nobel Peace Prize was never more worthily bestowed than when Nansen got it in 1923.

In 1925 he was elected Lord Rector by the students of St. Andrews, and in the following year he gave them a rousing rectorial address, in which he showed them how the spirit of adventure had been the unifying principle of his own life, inspiring his early explorations, his mature researches and the philanthropic missions in which he wore out the last of his tremendous strength. He said:

"It is our perpetual yearning to overcome difficulties and dangers, to see the hidden things, to penetrate into the regions outside our beaten track; it is the *call of the unknown*, the longing for the Land of Beyond, the divine force deeply rooted in the soul of men which drove the first hunters out into new regions, the mainspring perhaps of our greatest actions—of winged human thought knowing no bounds to its freedom."

The old love of adventure and the passion for research rose in a last flame of enthusiasm when he planned an airship voyage across the north polar basin in the *Graf Zeppelin*, and he had arranged to give a lecture on the subject to a joint meeting of the Royal Meteorological Society and the Aeronautical Society in March last; but the fatal illness baulked his will. He died at his home in Lysaker in his sixty-ninth year on May 13, 1930. Had he been able to lecture in March he would have tried to convince the sceptical British men of science of the soundness of his plans as he had tried to convince the British admirals in 1893. As in that case he would probably have failed, but had he lived to return successful, the doubting meteorologists, like the doubting admirals before them,

would have been whole-hearted in acknowledging that he was right. Nansen knew this well, and in one of his last letters to me he wrote: "I think I have had some evidence and experience as to the ability of your people to appreciate the achievements of foreigners as much as those of your own people. In fact, I never felt that I was a foreigner in England or Scotland." Their sense of kinship with Nansen led his British friends to initiate the *Fram* Preservation Fund while he was still alive, and now they can think of no worthier memorial to the man in his own land than the old ship secured for ever against the tooth of time, like the *Victory* at Portsmouth. HUGH ROBERT MILL.

DR. FRANK R. BLAXALL.

DR. F. R. BLAXALL, who died on May 24 after a brief illness, was bacteriologist to the Vaccine Department of the Ministry of Health, a post he had held for just over thirty years. He established the Government Lymph Institute at Hendon and was responsible during this period for the preparation of the vaccine lymph issued by the Government, and the high reputation which this product deservedly enjoys is largely due to his care and painstaking work.

Blaxall received his medical education at University College and Hospital, and obtained his M.D. (Lond.) degree in 1890 with honours in medicine. After holding several resident hospital posts, he was appointed lecturer in bacteriology at Westminster Hospital Medical School and in 1896, in collaboration with Dr. Colcott Fox, published an important paper on ringworm in London. He now came under the influence of the late Sir Armand Ruffer and Prof. Allan Macfadyen at the British (now Lister) Institute of Preventive Medicine, and at its old headquarters in Great Russell Street investigated the bacteriology of rheumatoid arthritis, and with Macfadyen published a paper on the thermophilic bacteria—one of the early contributions to this subject. In 1896 he commenced an investigation with Dr. Monckton Copeman on the inhibitory action of glycerin upon the adventitious micro-organisms present in calf lymph, and their results were communicated to the Local Government Board and to the Royal Commission on Vaccination then sitting, the outcome of this work being Blaxall's appointment as bacteriologist to the Vaccine Establishment, then in Lamb's Conduit Street.

From thence onwards, Blaxall's work was mainly concentrated upon vaccine lymph, and he published papers on the preparation of calf lymph and on the sterilising action of glycerin and of oil of cloves upon the adventitious micro-organisms of vaccine lymph, respecting which he became a recognised authority. He served as a member of the Smallpox and Vaccination Commission of the Health Committee of the League of Nations and of the Departmental Committee on Vaccination. To lifelong friends and colleagues, Blaxall's loss is indeed a heavy one.

R. T. HEWLETT.

WE regret to announce the following deaths:

Sir Thomas Walker Arnold, C.I.E., professor of Arabic in the University of London, English editor of the "Encyclopaedia of Islam", on June 9, aged sixty-six years.

Prof. J. B. Bradbury, for the past thirty-six years Downing professor of medicine in the University of Cambridge, on June 4, aged eighty-nine years.

The Right Rev. G. F. Browne, formerly Bishop of Stepney and of Bristol, sometime secretary of the Local Examination Syndicate at Cambridge and also (1887–92) Disney professor of archæology in the University, on June 1, aged ninety-six years.

Major Sir Aston Cooper-Key, C.B., formerly chief inspector of explosives at the Home Office, on May 28, aged sixty-nine years.

Dr. Kiyoo Nakamura, honorary member of the Royal Meteorological Society, who was director of the Central Meteorological Observatory of Japan from 1895 until 1923, on Jan. 3, aged seventy-five years.

Mr. E. A. Sperry, inventor of the Sperry gyro-compass and other gyroscopic appliances, on June 16, at sixty-nine years of age.

Dr. G. N. Stewart, professor of physiology, Western Reserve University, Cleveland, Ohio, on May 28, at seventy years of age.

Mr. A. F. R. Wollaston, fellow and tutor of King's College, Cambridge, who served as medical officer and naturalist to the first Mount Everest expedition under Col. Howard Bury, on June 3, aged fifty-five years.

News and Views.

SIR ARTHUR KEITH'S lectures on recent discoveries of fossil men, delivered at the Royal College of Surgeons during the month of May, and published in an abridged form in this week's Supplement, are likely to provide material for argument among anthropologists for some time to come. During the last decade, but especially in the last four or five years, there have been some remarkable accessions to our knowledge of early types of man. Palestine, Gibraltar, South Africa, East Africa, and most recently China, each in turn has yielded to the spade new types or new variants of known types. Each of these discoveries, it is safe to assume, helps us a stage on the way to final truth; but for the moment, it must be admitted, they add to the complexity of the problem which the anthropologist seeks to solve. Sir Arthur Keith's lectures, in a comprehensive survey of the new material, aimed at showing how it could be adapted in building up a scheme of the origin, development, and distribution of early man. One of the most interesting of recent discoveries with which he dealt—probably quite new to most of his audience—was that of the remarkable skull from Gardar in south-west Greenland, for the description of which he was indebted to Dr. Hansen of Copenhagen. This skull is not, indeed, one of high antiquity, for it was found in association with the remains of Norsemen in a twelfth-century graveyard; but whether it be regarded as atavistic, as Dr. Hansen holds, or pathological as Sir Arthur Keith is inclined to think, its

remarkable character, which would place it in a class with the more primitive types of fossil men, invests it with the utmost significance morphologically irrespective of its date. It is possible, as Sir Arthur said, that it reproduces a stage of man's evolution which may yet be discovered in a fossil state. It is, perhaps, not inapposite to point out that the Neanderthal skull itself was once considered to be pathological.

So many points of interest were raised by Sir Arthur Keith's lectures that it is difficult to single out any which call for special mention. Not unnaturally his audience was anxious to hear his views on Peking man, now that more detailed information has been so generously laid before English anthropologists by their colleagues in China. While his conclusions agree with those already expressed by Dr. Davidson Black and Prof. Elliot Smith as to the relation of Peking man with *Pithecanthropus erectus*, as he points out, the low estimate of the cranial capacity raises a serious problem as to the rate of growth in the size of the brain in the upward scale of human evolution, if, that is, the dating of Early Pleistocene is correct, as there is every reason to believe. The tribute paid to the scientific accuracy with which the investigations attendant on the discovery have been carried out were no more than is deserved. If we owe it to the workers in China enumerated by Sir Arthur Keith that we now know what manner of being was early man in eastern Asia, an equal debt is due to Mr. Leakey for his work in East Africa which has given us Elmenteita man and to Miss Garrod who at Shukbah and Mount Carmel in Palestine has not only brought to light the most complete sequence of palæolithic cultures yet to be found in that area, but has also revealed to us the skeletal remains of the hitherto unknown people who followed upon the Neanderthal race discovered by Mr. Turville Petre in 1925. The interesting inferences which Sir Arthur Keith drew from these and other discoveries upon which he touched may be left to speak for themselves. It may be noted, however, how individual discoveries of recognised importance have gained in significance as they have here been brought into relation one with another. Europe, once almost the only field for the investigator, no longer bounds the horizon, and the farthest corners of the earth now yield their share towards solving the problem of man's origin, growth, and distribution.

ON June 26 occurs the bicentenary of the birth of the French astronomer Charles Messier, who was born in 1730 at Badonviller, in the Department of Meurthe et Moselle. Like Lalande, he was attracted to astronomy by the eclipse of the sun of 1748, and at the age of twenty he went to Paris, where Delisle obtained a position for him connected with the marine. He was the first in France to observe the eagerly expected comet of Halley, which he saw on Jan. 21, 1759, and from that time onwards he spent most of his life searching the heavens for comets and nebulæ. Louis XV. called him the 'comet ferret', and after the death of Lacaille, Messier was regarded as the foremost practical astronomer in France. He was elected a foreign member of the Royal Society in 1764, and obtained a seat in the Paris Academy of Sciences in 1770. He was also a member of the Academies of Berlin and St. Petersburg. He published a small catalogue of nebulæ in 1771 and another containing 103 entries in 1781, but his work in this direction was soon surpassed by that of Herschel.

LIKE his contemporaries Messier lost his pension at the Revolution, and it was only with the assistance of Lalande he was able to continue his observations at Cluny. His discovery of a comet in the constellation Serpentarius was made in September 1793 in the midst of the Reign of Terror, and it was the orbit of this comet the unfortunate Bochart de Saron calculated a few days before his death. After the Revolution Messier was given a seat in the Institute, and became a member of the Bureau des Longitudes. In his eighty-sixth year he was attacked by paralysis, and he died in Paris on April 11, 1817, having been blind for some time.

STANDARDISATION, however undesirable in some spheres of human activity, has manifest advantages when applied to industrial processes and products. A conference which was recently held to examine the requirements of the chemical industries in respect of the formation of a British chemical standardising body, which would do for chemistry what the British Engineering Standards Association is doing for engineering, found itself unanimous in the opinion that such a body should be constituted. It cannot be denied that standardisation plays a very important part in securing industrial efficiency and economy, and is, in fact, an essential feature in the rationalisation of industry. Even standardisation may be standardised, and the view is crystallising that there should be a single organisation embracing all forms. In the British Engineering Standards Association there are twelve sections representing different industries, each section enjoying entire autonomy under a central Council within the terms of the charter. It has been proposed that the chemical industries should make use of the organisation which already exists, and steps have been taken to change its title to 'The British Standards Association', so that it may be in a position to embrace all forms of standardisation. The conference of representatives of organisations connected with chemistry, and of industries utilising chemistry, shares the view that a single organisation is desirable, and has agreed to the appointment of a committee to explore the situation as regards chemical standardisation in collaboration with the British Engineering Standards Association.

THE first complete technical account of the notable German Atlantic liner *Bremen* was published on May 24 in a special issue of the *Zeitschrift des Vereines Deutscher Ingenieure*, and from this the *Engineer* is publishing an account of her propelling machinery. The first part appeared in the issue for May 30. The *Bremen* has twenty water-tube boilers, eleven of which are double-ended, delivering steam at 327 lb. pressure, absolute, superheated to 350° C. The boilers are oil-fired and at sea, for the main and auxiliary machinery,

about 500 tons of steam per hour are required. The vessel carries about 1600 tons of oil-fuel in her double-bottoms and side bunkers. The main machinery consists of four sets of turbines, each consisting of a high pressure or intermediate pressure and low pressure turbine driving the four shafts through single-reduction gearing. The speed of the turbines is 1800 r.p.m., that of the propellers 180 r.p.m. The total power developed is 92,500 S.H.P. Designed to have a gross tonnage of 51,656 tons and a service speed of 26·25 knots, the *Bremen* has accommodation for 2200 passengers and a crew of 1000.

WE have received from the Institution of Electrical Engineers a revised supplement of the Institution's wiring regulations, which refers specially to the use of radio receiving sets connected with the public supply mains. Copies of these revised regulations can be obtained free of charge from the secretary of the Institution, Savoy Place, W.C.2. Emphasis is laid on the danger arising to the ordinary user when an ordinary 'all electric' set can be opened when still connected with the mains, thus exposing 'live' metal. When valves have to be inspected or changed, the apparatus should always be previously disconnected from both poles of the supply system. Manufacturers ought always to attach a notice to this effect to the case containing the radio apparatus. It is not safe to asume that the neutral conductor of a three-wire direct current system is always at zero potential. Should a fault develop in a main or should a circuit breaker in the link connecting the neutral conductor to earth be opened for testing purposes, there may be a potential difference of 200 volts between all the neutral system and earth. The full voltage of the station, between 400 and 500 volts, may also exist between earth and those conductors which normally operate at about 200 volts above or below earth. When using crystal sets it is important to keep all the wires of the set well away from any metal objects which might conceivably become alive from contact with the mains. The covers of metal switches used for lighting have been known to become alive. If there is no risk of the cover making contact through the body with a good earth, the chance of getting a shock is negligible and the fault may never be discovered. When, however, a good earth is brought near the cover, there is a real risk of shock.

IN his Friday evening discourse on unemployment, delivered at the Royal Institution on June 13, Prof. Henry Clay said that it is obvious that the interruption and dislocation of established economic relations by the War must affect Great Britain, with its immense international trade, more than any other country. The artificial prosperity produced by inflation between 1915 and 1920 also deferred any attempt to make adjustment to conditions that would have changed even if there had been no war; such as the discovery of methods of economising in the use of coal, or the growth of competition in the low-wage eastern countries in the textile industries. Three influences can be distinguished as hampering industrialists in their efforts to restore activity. First, the fall in world prices, the chief burden of which falls upon the directors and owners of businesses, on whom society relies for initiative and expansion. In the second place, the economic system has become more rigid: while wholesale prices have fallen 25 per cent since 1924, wage-rates have fallen only 1 or 2 per cent, and Government charges had increased. In the third place, the chief fund which fed the growth of industrial enterprise in new directions, and so provided expansion that compensated for lost and declining industries, the profit retained in the business by successful concerns, is now curtailed by high direct taxation. Before the War, of every pound applied to the development of industry by the management which had proved its capacity to develop by earning profit, only a shilling or so was taken by the State; now a quarter or a third is taken out of a diminished total. The proceeds of this taxation go to pay interest on debt and to finance social services; in this transfer of income from financing industrial development to financing consumption may be found, in part at any rate, an explanation of the activity of the luxury trades in a prolonged period of extreme trade depression.

AMONG the communications made to the Czech Academy of Science in 1927, and now recently published in the *Bulletin International* for that year, is one from Prof. Karel Domin dealing with the geology and natural history of the primeval woodlands of Boubín in the Šumava (Bohemian Forest mountains). This virgin forest is a classical region for the study of hercynian vegetation, having remained untouched for a very long period. The principal trees are the fir, beech, spruce, and, to a less extent, the maple. There is abundant herbaceous undergrowth, especially on the northern and marshy side. In the drier part, where deciduous trees predominate, a thick layer of friable humus has formed. A characteristic feature of the forest is the presence of spruces with stilt-like roots which have arisen partly through the growth of young plants on the trunks of dead conifers which have subsequently decomposed and partly by the falling away of the soil. This is well shown by Prof. Domin's set of photogravures illustrating the text. A comprehensive list of the flora is given, and it is shown how four distinct types may readily be delimited. These are (*a*) marshes and swamps, (*b*) quagmires and damp places in the forest, (*c*) places of medium humidity, and (*d*) alpine and rocky parts. All are relatively rich in characteristic vegetation. The animal life, however, is to-day relatively poor. The same issue of the *Bulletin*, which covers the natural and mathematical sciences and medicine, also contains an account of the geology of the Dalmatian island of Silba, by Dr. O. Matoušek, Prof. V. Posejpal's recent studies on fluorescence, some further work with the aid of the dropping mercury cathode by Prof. J. Heyrovský and his students, as well as several biological and histological contributions with illustrations in colours.

THE second Annual Report of the National Museum of Canada, although its title states that it is 'for 1927', covers the period from April 1, 1927, to

Mar. 31, 1928, and was published towards the end of 1929. It indicates that good progress is being made with the various exhibition series of specimens, anthropological, botanical, zoological, and geological, in the Victoria Memorial Museum in Ottawa to which the museum was transferred in 1920. But the space available for the exhibition of collections obviously falls far short of what is necessary, and compares unfavourably with the extent of such provincial museums as that of Ontario. The Director estimates that the present building must be increased by more than half as much again, at a cost of nearly a million dollars, to meet the requirements of the next twenty years or so. A substantial amount of field work was carried out by the various departments during the period reviewed, perhaps the most important of which, since opportunities become rarer, being the collection of 137 Niska songs, recorded in text form and on the phonograph, and the collection of two adult bulls of the wood buffalo. Of the 107 pages of the Report, 72 contain papers of ethnographical and zoological interest, the most unusual being an account of the materia medica, botanical and zoological, of the Bella Coola and other tribes of British Columbia ; slugs, we note, should be opened and applied over large cuts, and a draught of a decoction of sea-cucumber is a specific against heartburn.

THE British Golf Unions Joint Advisory Committee has issued a further interesting number of the *Journal of the Board of Greenkeeping Research*. Although the Research Station at St. Ives, Bingley, Yorks, has been in existence for less than one year, it has become more and more apparent that its establishment has been fully justified, judging from the rapid growth in the demand for its services. Owing to the large amount of advisory work that is necessarily an important feature of the station, it has hitherto been impossible for the present staff to carry out as much actual research work as is desired, and this fundamentally important part of the work can only be developed if the increased interest is accompanied by greater financial support. However, much progress has already been made, a number of experimental plots having been laid down and a nursery for stolon production established. One of the chief items in the present issue of the *Journal* deals with measures for eradicating worms, details of practical experience being supplied by various golf clubs. An account is also given of the formation of putting green turf by vegetative means, use being made of those species of grass which naturally form runners or stolons. The action of iron and ammonium sulphates on both grasses and weeds is the subject of a further article. One section of the *Journal* is devoted to the publication of typical inquiries and their respective replies. This is to be a permanent feature and should do much towards promoting interest and spreading authoritative information on the various problems of greenkeeping.

THE ultimate justification of the Empire Cotton Growing Corporation lies in the success it achieves in securing an increase in the production of Empire grown cotton, and in its report for 1930 it is able to show a fivefold increase to 466,544 bales. The work of its officers in the various cotton-growing territories is briefly reviewed, but, as this forms the subject of a separate publication (see NATURE, April 12, p. 553), the main interest of the present report centres in other subjects, and especially in the work of the Corporation's research station in Trinidad. This station was established to prosecute fundamental research " even if its objects might appear to be remote from immediate practical application ". Research papers from the station have appeared in the *Annals of Botany* and are republished in the form of *Memoirs* issued by the Corporation. Evidence is repeatedly given throughout the report of the difficulty of limiting the field of inquiry to the narrow scope of cotton. Sound agricultural practice inevitably involves rotations, and investigations have to be extended to other fields. Thus in South Africa it is noted that more attention has been devoted to " the important question of rotation crops ". Again, it is useless to produce a crop if the produce cannot be marketed. The pioneer work of the Corporation in mechanical transport is now being continued by the Oversea Mechanical Transport Directing Committee, but contact is maintained through the director of the Corporation, who is chairman of that Committee.

THE Report for the year 1929 of the National Physical Laboratory is a quarto volume of 300 pages, 230 of which are devoted to particulars of the researches carried out in the physics, electricity, metrology, engineering, aerodynamics, metallurgy, and Froud tank departments respectively. The amount of work done for industrial firms exceeds that in any previous year, while the research carried out for boards and committees of the Department of Scientific and Industrial Research which has a direct bearing on industry has been maintained. Materials for high pressure steam turbines, for aeroplane engines, for motor springs and chains, and lubricating oils have all been under investigation. A new building for the Physics Department is nearing completion and the construction of a compressed air tunnel is about to be commenced. New buildings for acoustics and for photometry are under contemplation, as well as a number of smaller additions rendered necessary by the increase of the demand for work by industrial firms. Nearly ninety official and twenty unofficial papers have been published by the staff in scientific and technical periodicals during the year, an output which affords ample evidence of their activity.

THE complete annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1928, has recently been issued. This volume, as is customary, includes a complete statement of the activities of the Institution, and in addition, a valuable appendix occupying 585 pages or about four-fifths of the volume, containing articles by authorities on scientific topics of current interest. Some of these are reprints of addresses which have already appeared in whole or in part in our columns ; for example, Sir James Jeans's Trueman Wood Lecture before the Royal Society of Arts on " The Wider Aspects of Cosmogony " ; the British Associa-

tion address at Leeds by Prof. R. A. Millikan, which appeared as a supplement to NATURE entitled "New Results on Cosmic Rays", by Prof. R. A. Millikan and Dr. G. H. Cameron; Dr. R. N. Rudmose Brown's presidential address at Leeds to Section E (Geography) of the British Association on "Some Problems of Polar Geography". There are also contributions by Prof. J. W. Gregory on "Water Divining", being his presidential address in 1927 to the British Waterworks Association, Public Works, Roads, and Transport Congress, and the Arrhenius Memorial Lecture delivered before the Chemical Society by Sir James Walker on May 10, 1928.

VOLUME 18 of the Travaux et Mémoires of the Bureau International des Poids et Mesures (Paris: Gauthier-Villars et Cie, 1930) contains nearly 300 pages and gives accounts of the meetings of the international committee since 1921. The director, M. Guillaume, gives a short history of the progress of the metric system and of the search for the most satisfactory materials for standards, and contributes a memoir on the mercury in glass thermometer. The old 'verre dur' used by Tonnelot and Baudin in the 'eighties is no longer made and this has entailed a search for a glass equally good. It is now found that a thermometer with a bulb of Jena glass 16 M. and a stem of a green glass containing a small percentage of lead is the most satisfactory. M. Volet shows that the observations of Chappuis on the boiling point of water between 555 mm. and 825 mm. of mercury require for their accurate representation a trinominal in p. M. Perard gives an account of the interference methods used for the study and comparison of industrial gauges and similar end standards. The volume concludes with an account of the celebration of the jubilee of the foundation of the Bureau, held Oct. 5, 1927, when addresses were given by MM. Emile Picard, C. E. Guillaume, and Maurice Bokanowski.

THE Annual Report of the United States National Museum, Washington, D.C., which corresponds approximately to the British Museum (Natural History), to June 1929, states that at the close of the fiscal year the staff consisted of 47 professional and scientific employees, 42 sub-professional employees, 41 clerical, administrative, and fiscal workers, and 181 in the custodial service—311 in all. In addition, some 54 other specialists hold honorary appointments in the Museum, many of whom devoted much time to work on the national collections. Better conditions of pay have been arranged for the staff, the greater part of the increase of 97,064 dollars in the annual grant having been applied to much-needed adjustment in the salary scales, and one gratifying result has been that the personnel has tended to become more stable. The number of specimens added to the collections continues to increase, and a survey of the materials in the various departments brings the total number of specimens to 12,029,469, but even this survey is not complete. Biology alone contains 8,848,367 specimens. In view of this increase, it is not surprising to find that the Director complains of congestion in the present space occupied by the Museum collections, in spite of directive effort to select for preservation only the objects that must be kept and to eliminate material that is not permanently desired.

A RECENT addition to the valuable catalogues of the collections of objects in the U.S. National Museum deals with objects of religious ceremonial. It is uniform with the catalogue of objects used in the production of fire and light issued not long ago, and forms *Bulletin* No. 148 of the U.S. Museum. The author is the late Dr. Immanuel Casanowicz, who died in 1928, after many years' service as assistant curator of the Division of Old World Archæology. The catalogue covers the Jewish, Christian, Eastern Church, Mohammedan, Hindu, Buddhist, Parsee, and Shinto religions. It is well illustrated by a large number of plates figuring ritual objects and implements, medals, crucifixes, ikons, statues of the Buddha, sacrificial accessories and the like which are in the museum. Not merely are the objects of the collections described, but notes on ceremonial and function are added which raise the work from a mere catalogue to the status of a brief introductory manual to the ritualistic side of each religion in turn. Such catalogues of classified objects cannot compare with the more comprehensive catalogues of the ethnographical and archæological collections in the British Museum, either in appearance or in the nature of their contents; but at the same time it must be recognised that they are of the greatest value to the student of the various branches of culture, as they bring the material ready to his hand in convenient association.

THE two handsome volumes, 1200 pages in all, constituting the annual report of the Director of Veterinary Services, Onderstepoort, Pretoria (Union of South Africa Department of Agriculture. Pretoria: Government Printer, 1929. 10*s*. each vol.), contain details of a number of important and interesting researches on protozoal, virus, and bacterial diseases of animals, parasitology, pathology, poisonous plants, sterility of cows, and mineral deficiency of the Veld. Further outbreaks of botulism among animals and birds are recorded (E. M. Robinson). A new schistosome, *S. mattheei*, from sheep is described (F. Veglia and P. L. le Roux). Skin cancer of the Angora goat in South Africa is dealt with in an exhaustive paper by A. D. Thomas, who remarks that tumours in the lower animals are not a rarity in South Africa. The phosphorus deficiency of the Veld soil and pasture is indirectly the cause of a disease, lamsiekte (parabotulism), of cattle, and is preventible by supplying rations of bonemeal, as described in a previous report (1927). It is now found that the bonemeal has also a remarkable influence in increasing the fertility of the cows in the district as well as causing more regular breeding (P. J. du Toit and J. H. R. Bisschop). The report is well produced and profusely illustrated with excellent plates, and is worthy of a better binding.

SIR WILLIAM BRAGG, director of the Royal Institution and of the Davy-Faraday Research Laboratory, has been elected a corresponding member of the Vienna Academy of Sciences.

THE third Imperial Entomological Conference was opened in London on June 17 by Lord Buxton. The meetings of the Conference are being held in the rooms of the Entomological Society of London, 41 Queen's Gate, S.W.7. Among the subjects of discussion are: Organisation of entomological departments; entomological work among backward races; tsetse control; control of insects by cultural methods; locusts; biological control of insects; control of weeds by insects; and control of orchard pests. In connexion with the Conference, the Imperial Bureau of Entomology has issued a list of entomologists employed in the British Empire, and a summary of data relating to economic entomology in the Empire.

A COMMITTEE has been appointed by the Secretary of State for the Colonies, in consultation with the Secretary of State for India and the Forestry Commissioners, to consider and report on the training of candidates and probationers for appointment as forest officers in the government service. The members of the Committee are: Sir James Irvine, principal of St. Andrews University (Chairman); Mr. G. E. S. Cubitt, late Conservator of Forests, Malaya; Sir Thomas Middleton, Development Commissioner; Mr. R. L. Robinson, vice-chairman of the Forestry Commission and Technical Commissioner; Mr. F. W. H. Smith, assistant secretary, India Office; Mr. C. G. Trevor, late vice-principal and professor of forestry, Dehra Dun, India; Major R. D. Furse, private secretary (Appointments) to the Secretary of State for the Colonies. Mr. G. H. Creasy (Colonial Office) has been appointed secretary to the Committee.

THE Medical Research Council announces that on behalf of the Rockefeller Foundation it has made the following awards of travelling fellowships for the academic year 1930–31. These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine and surgery, and are likely to profit by a period of work at a chosen centre in America or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles: Mr. R. C. Brock, Guy's Hospital, London; Dr. F. B. Byrom, London Hospital; Mr. D. Curran, Hospital for Epilepsy and Paralysis, Maida Vale, London; Dr. A. A. Moncrieff, Hospital for Sick Children, Great Ormond Street, London; Mr. A. S. Paterson, Royal Glasgow Mental Hospital; Dr. C. C. Ungley, Royal Victoria Infirmary, Newcastle-on-Tyne. Dr. Moncrieff's fellowship is tenable at Hamburg; the others at centres in the United States. Mr. Brock and Dr. Curran have been appointed on modified conditions while receiving emoluments from other sources.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in education in the Department of Education of the University of Birmingham—The Secretary, University, Birmingham (June 24). A principal of the Northern Polytechnic—The Clerk, Northern Polytechnic, Holloway, N.7 (June 27). A horticultural superintendent under the County Council of the Isle of Ely—The Director of Education, Education Offices, March (June 28). A lecturer in rural science at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Essex County Council, Shire Hall, Chelmsford (June 30). A district agricultural organiser and lecturer in dairy husbandry at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Essex County Council, Shire Hall, Chelmsford (June 30). An assistant lecturer in mathematics in the University of Leeds—The Registrar, The University, Leeds (June 30). An assistant lecturer in physics at the Cardiff Technical College—The Principal, Technical College, Cardiff (July 2). A professor of physics in the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (July 4). A professor of chemistry and head of the department and a professor of physics and head of the department of the Muslim University, Aligarh, U.P., India—Vice-Chancellor S. R. Masood, c/o Box 10, c/o NATURE Office (July 4). A professor of mechanical engineering at the Bengal Engineering College, Sibpur, Bengal—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (July 5). A lecturer in mining at the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (July 5). A lecturer in education in the University of Durham—The Secretary of the Joint Board, University Offices, North Bailey, Durham (July 7). Chief lecturers in, respectively, mechanical engineering, electrical engineering and metallurgy, at the Rotherham Technical Institute—The Director of Education, Education Offices, Rotherham (July 8). A demonstrator of physics at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S.E.1 (July 10). A clinical research worker in mental deficiency under the Medical Research Council, the Governing Body of the Darwin Trust, and the Committee of the Royal Eastern Counties Institution for the Mentally Defective at Colchester—Miss Darwin, The Orchard, Huntingdon Road, Cambridge (July 13). A professor of zoology in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Aug. 31). A senior lectureship in education in the University of Liverpool—The Registrar, The University, Liverpool (Sept. 30). A lecturer in education at the Brighton Municipal Training College for Women—The Secretary, 54 Old Steine, Brighton. A graduate teacher for mathematics and engineering drawing at the Cumberland Technical College, Workington—The Principal, Cumberland Technical College, Workington. Masters for, respectively, mathematics, and mathematics and physical science, under the Education Department of Southern Rhodesia, for European Schools—The High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2. An aero examiner (metallurgist) under the Aeronautical Inspection Directorate of the Air Ministry—The Secretary (I.E.2), Air Ministry, W.C.2. An assistant in the department of geography of University College, London—The Secretary, University College, Gower Street, W.C.1.

Research Items.

'Bar-lip' Pottery from Essex and Alderney.—In *Man* for June, Mr. T. D. Kendrick figures and describes two fragments of pottery recently acquired by the British Museum, one from Barkingside, Essex, presented by Mr. Hazzledine Warren and Mr. Ryde, and one from the late-Roman fort known as the "Nunnery," Longy Bay, Alderney, presented by Lieut. C. S. Durtnell. The first was part of a bowl about 20 cm. in diameter which probably had a round base. It was a wide-mouthed pot with pinched-in neck and lip slightly everted, but its most remarkable feature was that at its rim there were three large protruding spouts across which the rim of the pot is carried in the form of a deep and thickened bar. The bowl is hand-made, clumsily modelled, of a coarse gritty ware and deep smoky brown on both faces. The Alderney specimen has a single spout of much the same size as those on the Essex bowl, but the potting is of a much higher character. In the Museum für Vaterländischen Alterthümer at Kiel are fragments of at least three bowls of the same type, all coming from Haithabu (Hedeby) at the east end of the Danewirke, a famous mart in Viking days. This gives a date of from ninth to twelfth century for the Kiel specimens, and as the Vikings copied Frankish models, the protype must be sought in Frankish pottery. A jug from Aubres, near Nyons, in the Drôme department of France, shows where the Vikings may have seen something of the sort. The clumsy bowl from Barkingside may be an early attempt, perhaps of the ninth or tenth century, introduced by Vikings from Frisia, while the Alderney fragment may be later, possibly eleventh century introduced to the island by Rollo's men. Dr. Cyril Fox has pointed out to the author that there are similar fragments in the Cambridge Museum for Archæology and Ethnology from Abington Piggots, Cambridgshire.

Totemism in Eastern Australia.—A systematic study of the social organisation of Australian tribes has now been instituted by the Australian National Research Council by means of funds provided by the Rockefeller Foundation. As a result, our knowledge of Australian totemism and related phenomena is being greatly extended. Views hitherto current relating to the system of Arunta totemism as described by Spencer and Gillen are being re-examined. Prof. Radcliffe-Brown contributes to vol. 59, pt. 2 of the *Journal of the Royal Anthropological Institute* the results of an investigation among a number of tribes in the northern part of New South Wales in which the special problem was the relation between man and Nature in myth and ritual. It was found that each of the tribes in question performed rites for the increase of natural species. Each tribe is organised into hordes—small exogamous local patrilineal clans. The characteristic feature of the cult among them is that there are several sacred spots belonging to each horde at which increase rites are performed. These spots are marked usually by a water hole, and sacred trees or peculiar stones or rocks. Each is associated with some particular natural species and the rites are simple, usually consisting of stirring up the water-hole, throwing mud at the trees, and so forth. There exists also a system of myths associating the sacred spot with the acts of mythical beings. A cult conforming to this general pattern is widespread in Australia, but with local variations, of which Aranda totemism with its conception of reincarnation is one. It is possible that among the Aranda the association between the increase rite and the horde may be found still to exist. It is concluded that the problem of totemism can only be solved when we have a satisfactorily wide theory of the relation in myth and ritual between man and Nature in the less developed societies both totemic and non-totemic.

Alcoholism.—The May issue of the *Bulletin of Hygiene* contains a review of recent literature on alcoholism by Dr. J. D. Rolleston. Previous contributions to this subject by Dr. Rolleston during the last two years have been noted in NATURE of Aug. 25, 1928, p. 285; April 20, 1929, p. 615; Aug. 10, 1929, p. 245. The present review deals with its historical aspects, its prevalence in various countries, with special reference to the cocktail habit and methyl alchol drinking, experimental work, alcohol and aviation, alcohol and economics, the association of alcoholism with other morbid conditions, the decline of alcohol in therapeutics, the diagnosis of alcoholism by colorimetric methods, alcohol and longevity, legislation and treatment. A bibliography of thirty-six references to the literature of nine different countries is given.

Biochemical Aspect of the Recapitulation Theory.—The text of a very interesting paper under this title by Dr. Joseph Needham, in *Biological Reviews*, vol. 5, April 1930, may be said to be the observation that the chick embryo for a short time in its early development excretes 90 per cent of its nitrogen as ammonia, then for a short time 90 per cent as urea, and finally 90 per cent as uric acid. From the recapitulatory point of view this is very suggestive since marine invertebrates excrete their waste nitrogen as ammonia, fishes and amphibia as urea, and sauria and birds mainly as uric acid. Needham brings into line with these observations a number of other biochemical data; for example, the appearance of hormones in the developing embryo, none being present in the unfertilised egg, whilst they are also notoriously deficient in the invertebrates. Needham argues that recapitulation may be regarded as fundamentally the result of the necessary passage from simplicity to complexity, from low to high organisation, which is entailed by the metazoal sexual system of reproduction, with its single egg cell.

Vole Cycles in Great Britain.—In view of the enormous destruction which has occasionally been caused in Great Britain owing to abnormal plagues of voles or short-tailed field mice (*Microtus agrestis* and *hirtus*), the importance of an understanding of their bionomics is of obvious importance. For some time A. D. Middleton has been endeavouring to collect from foresters, farmers, and naturalists, records of the annual fluctuations of this pest, and his investigation shows that there is a well-marked periodicity in numbers (*Jour. Ecology*, vol. 18, p. 156). Maximum numbers occur approximately every fourth year, and the graph which illustrates Mr. Middleton's paper shows that unusually large numbers were present in 1922 and 1926. On these facts a vole plague (possibly on a smaller scale) may be looked for in the autumn of the present year, but there is a possibility that the graph may be misleading as regards intensity, since reporters are more likely to retain vivid memories of the more recent events. Steps are being taken, however, to place future records on a more reliable statistical basis. The causes of the cycle are not yet fully understood, but there is evidence that, as in so many other rodent plagues, disease is a controlling factor in some instances, although climatic factors are also involved.

Hair of the Fossil Ground-Sloth (Nototherium).—A reprint received from Leon Augustus Hausman (the source of which unfortunately is not indicated) gives an interesting account of a peculiar feature of the hair of the fossil ground-sloth (*Nototherium shastense*) recently set up in the Peabody Museum. Only one sort of hair could be seen, corresponding to the over-hair of modern mammals; there was no trace of an undercoat of fine hair. The shafts of the hair showed the typical structures, medulla, cortex, cuticle, and pigment granules, and the cuticular scales could easily be distinguished. Where the scales were present, there occurred on the surface of the shaft minute oval bodies which suggested the algal cells present on the hairs of modern South American sloths. Nothing like them has been seen on the hairs of several hundred mammal species examined, and the author, though he does not commit himself, leans to the opinion that they represent an algal association on the hair shafts. We take this opportunity of directing the attention of readers to an excellent and fully illustrated article by the same author on "recent studies of hair structure relationships" in the *Scientific Monthly* for March.

Control of Greenhouse Red Spider.—A new leaflet (No. 99) has been issued recently by the Ministry of Agriculture on the subject of the greenhouse red spider. This extremely small, but notoriously injurious pest attacks many glasshouse plants, and since it is able to increase with extraordinary rapidity, readily becomes a serious menace to growers. Cucumbers and tomatoes are chiefly affected, the plants becoming hardened and stunted in growth, and the leaves injured. Among crops in the open, hops and strawberries are particularly liable to damage. The attack usually begins in the spring and continues during the summer, when the many successive generations feed and lay their eggs upon the under sides of the leaves. In October the female, after fertilisation, changes from a greenish black to a brilliant red colour. In this condition the mites leave the plants, preparatory to hibernation, become gregarious, and live in a common web. Although they do not feed in the winter, they only become inactive at temperatures far below freezing point. As regards methods of control, fumigation with naphthalene is extensively used for cucumbers, but is not suitable for tomatoes or carnations. Spraying with petroleum emulsions is also an effective measure against attacks on cucumbers or tomatoes, but should not be used for carnations or peaches. For the two latter crops, liver of sulphur is particularly suitable, but for safety spraying must be done in the evening or during dull weather. Other remedial methods are also quoted, and details of the quantities and the conditions under which the various fumigants and sprays are used to best advantage are supplied.

Species and Races in the Salmonidæ.—The work of Dr. H. Henking on salmon, sea-trout, and trout is of great interest. In his memoir "Untersuchungen an Salmonidae mit besonderer Berücksichtigung der Art- und Rassenfragen. Teil I." (Conseil Permanent International pour l'Exploration de la Mer. *Rapports et Procès-Verbaux des Réunions*. Volume 61, November 1929) he describes his experiments dealing with racial studies which were undertaken at the instigation of the Limnological Committee of the Council at its meeting in June 1928. In addition to the experimental work a large amount of material has been examined which was collected for many years by Germany, chiefly from the Pomeranian coast, but also from the west coast of Schleswig-Holstein and some samples from the North Sea. As is well known, the salmon and the sea-trout pass their life between sea and fresh water, whilst the trout lives almost wholly in fresh water. It is shown in this report that pond trout, if transferred to slightly salt water, such as the Baltic, grow so like the sea-trout that it is almost impossible to distinguish them, although there is a tendency at first to return to the fresh water. When established in the Baltic, however, the fish grew to a large size. The conclusions are that the salmon is a distinct species, the trout and sea-trout together forming another species, although the two latter usually can be easily distinguished by their size and habits of life. Salmon and sea-trout are sometimes difficult to separate, but Dr. A. C. Johansen has shown that there are differences in the gill rakers. Such differences, together with those in the vomer and the os lingue, are here shown to be good distinguishing characters. Hybrids can be produced artificially between salmon and trout, salmon and sea-trout or trout and sea-trout, but so far no natural hybrids are positively known.

Cocksfoot Grass.—The result of a four years' field trial between indigenous, New Zealand, Danish, and French cocksfoot grass is the subject of an article by Prof. Stapledon in the *Welsh Journal of Agriculture*, vol. 6. New Zealand and indigenous strains are closely allied and differ greatly from the Danish and French types. Although the latter start growth earlier in the spring, and may give the better yield in the first two harvests, the New Zealand and indigenous strains invariably produce the best aftermath and are decidedly the most persistent; further, they are more winter green and their sward is less weedy. The leaf to stem ratio in the shoot is higher in the New Zealand and indigenous species than in the Danish and French, and since the heaviest response to manuring, from the point of view of yield, is obtained when the bias is in this direction, it is specially worth while to apply liberal dressings of fertilisers to those leafy strains of the grass. The effect of different cutting and manurial treatment on tiller and root development of cocksfoot is also described in the same volume, both pasture and hay *cum* aftermath systems being considered. As regards yield, the plants cut as hay and aftermath gave the best results, but plants cut to 6 in. at fairly frequent intervals considerably outyielded and also showed greater root development than those cut to ground level. This would point to the necessity of avoiding close and continuous grazing if the productivity of a pasture is to be maintained. Nitrogen applied as nitro-chalk in heavy incremental dressings had a more pronounced effect on hay *cum* aftermath than on pasture, but all systems of cutting showed a response to nitrogen. A continued plucking of inflorescences was found to increase tiller and root development. The soundness of the practice of running the mowing machine over pastures (at intervals if necessary) to remove excess of flowering-shoots is therefore upheld.

Giant Senecios on Kilimanjaro.—Following the recent British Association visit to South and East Africa, accounts of vegetation from interesting localities continue to appear from the pens of botanists fortunate enough to take part in this tour. In the *Kew Bulletin*, No. 3, 1930, Mr. A. D. Cotton has an interesting account of earlier botanical exploration of Kilimanjaro. This mountain, with its volcanic crater, is likely to be more accessible in future to British visitors who may approach it, as did Mr. A. D. Cotton (and Dr. A. S. Hitchcock of the Smithsonian Institution) from the direction of Amani. The two travellers were able to break their rail journey from Amani to Nairobi at Moshi, the bi-weekly train service per-

mitting time for a considerable ascent of the mountain. The recently opened Kibo Hotel at Marangu provides a suitable base of operations on the south side of the mountain and the proprietor of the hotel owns two conveniently placed resthouses on the slopes at altitudes of 8500 feet and 11,500 feet respectively. In four days the two travellers were able to make a comparatively leisurely ascent, Dr. Hitchcock collecting up to 14,000 feet altitude, and the list of plants brought back by Mr. Cotton shows that a considerable amount of valuable work could be carried out in this period. Mr. Cotton's account is illustrated by some excellent photographs, taken by Dr. Hitchcock, of the arborescent Senecios on the rocky slopes. One of these is described as a new species, *S. Cottonii* Hutch. and Taylor. It was not recognised as new until brought back to Kew, so that its altitudinal limits are not clearly known, but it probably grows at higher altitudes than *S. Johnstonii*, which grows on the same mountains and is named after Sir Harry Johnston.

Observations by Pilot Balloons.—The Swedish Meteorological and Hydrographical Office has collected together as part 10 of *Årsbok* for 1928 a number of meteorological observations taken at high altitudes. These include aeroplane observations at the aviation stations of Malmslätt and Ljungbyhed throughout the year, and reading by pilot-balloons at Malmö and Göteborg for the great part of the year, and at Stockholm, Östersund, and Abisko for the whole year. Most of the observations were made below four thousand metres, but a few were made at several stations above five thousand metres. At most stations the observations, which are printed in full, were taken almost every day in the month. They include temperature, humidity, pressure, wind and cloud.

Superconductors.—Measurements made at the Leyden Cryogenic Laboratory during the past ten years have established the fact that the following pure metals become superconducting at the absolute temperatures given—lead 7·2°, mercury 4·2°, white tin 3·8°, indium 3·4°, thallium 2·5°, and gallium 1·1°. Measurements have been made more recently by Profs. de Haas, van Aubel, and Voogd on the resistivities of alloys of these metals with each other and with other metals not showing superconductivity at temperatures at present attainable. Their results are given in Leyden *Communications* 193, 197, and 199. When thallium is alloyed with bismuth or tin with antimony superconductivity occurs at a higher temperature than it does in the pure metal, but when tin is alloyed with silver or copper the alloy is not superconducting. On the other hand, an alloy of 4 per cent bismuth in gold becomes superconducting at 1·9° although neither constituent is superconducting. In the *Transactions of the Royal Society of Canada* for April, Prof. J. C. McLennan and Messrs. Allen and Wilhelm show that by the addition of bismuth to lead or to lead-tin alloys the temperature at which superconductivity begins may be raised, for example, to 8·8°, that is 1·6° above that for pure lead.

Spectroscopy of the Night Sky.—The April number of the *Canadian Journal of Research* contains a paper by Prof. J. C. McLennan and Mr. H. J. C. Ireton, describing a special spectrograph for investigation of light from the night sky. The instrument has not the usual symmetrical form, the collimator lens being an achromatic cemented doublet of 50 mm. aperture and 56 cm. focus, and the camera lens either a single aspherical lens designed to give the maximum concentration of light for the mercury green line, or a four-component F/1 lens of 50 mm. focus, designed to give good focus of the entire spectrum on a flat but tilted plate. The instrument is mounted so that the collimator can be readily directed to any part of the sky. Some tests which have been made at various stations in Canada and England, using the compound camera lens, have shown that the green line (5577 A.) from the non-polar aurora can be photographed in as short a time as ten minutes under favorable conditions, so that it will be now easily possible to follow the change in intensity of this radiation throughout the night, as well as to study the radiation coming from different parts of the polar aurora. With exposures of between one quarter and one half of an hour, with a slit 1 mm. wide, six lines were obtained in the spectrum of the light from the polar aurora, in addition to the green line and the two nitrogen bands at 3914 A. and 4278 A.

Crystal Structure of Normal Paraffins.—Dr. A. Müller has contributed a paper to the May number of the *Proceedings of the Royal Society* on the crystal structure of the normal paraffins, based on an X-ray investigation of a number between C_5H_{12} and $C_{30}H_{62}$. Between liquid air temperature and the melting-point, the coefficient of expansion has been found to be different for each of the two axes perpendicular to the carbon chain, and the expansion in the last direction is too small to be measured under the conditions of experiment. The higher hydrocarbons have been shown to crystallise in a form which is the same for odd and even members, differences between the behaviour of the two types of molecules first becoming apparent when the carbon content is decreased. About $C_{20}H_{42}$, two alternative structures are found for each compound in the even series, whilst in the odd series the transition takes place between $C_{11}H_{24}$ and C_9H_{20}. An observation of special interest is that the substances tend to form layer structures in the immediate neighbourhood of the melting-point; the two sets of orientations of the cross-sections of the molecules appear to give place to a more or less definite single orientation, and it is suggested by Dr. Müller that it may prove possible to influence the balance of the internal forces in the crystal in a similar way by an external electric or magnetic field in this region.

Photolysis of Aqueous Hydrogen Peroxide.—The April number of the *Journal of the Chemical Society* contains two papers on the above subject by Allmand and Style. The results were found to be very complicated. The velocity of decomposition was found to vary with the square root of the light intensity, an unexpected result which suggests the formation of a catalyst by the action of light. The effect of concentration was also unexpected, since the quantum efficiency increased steadily as the solution was diluted, and the thermal velocity also increased over the greater part of the concentration range covered. In some cases the quantum efficiency passed through a maximum with constant intensity as the concentration of peroxide increased. The value of the quantum efficiency indicated a catalytic chain with a life of about 1 sec. The theoretical bearings of these results are discussed, including the observation that the temperature coefficients of photolysis decreased with increasing frequency, which suggests that they are concerned with the primary process only. It is suggested that, since only a very small proportion of the absorbing molecules react after absorption, the reaction chains must be very long. The square root relation suggests that the catalyst, of mean life of 1 sec., may consist either of OH groups or oxygen atoms, produced in the liquid phase. It is pointed out that a complete theoretical interpretation of the results cannot be given at present.

Photo-Electric Cells.

THE recent discussion on magnetism (see NATURE, June 7, p. 874) afforded an example of a symposium on a subject academic and in some respects aloof from the problems of everyday life. The discussion on June 4 and 5, organised jointly by the Physical and the Optical Societies, is at the opposite pole. Although the photo-electric effect both raises and resolves many recondite problems in modern physics, its applications may touch modern life at points so far distant as photo-therapy and greyhound racing, and it was in great measure on applications that the interest of the discussion centred.

That a metal plate, exposed to the light from an arc, acquires a positive potential — indicating therefore the emission of electrons—was observed so long ago as 1888 by Hallwachs, and facts of fundamental importance were rapidly accumulated by Elster and Geitel, who demonstrated in particular that, while ultra-violet light was the effective agent in establishing the positive potential of an ordinary metallic plate, the alkali metals, sodium, potassium, and rubidium, were sensitive to rays from the luminous portion of the spectrum.

Einstein in 1905, using the hypothesis of light quanta, showed that the maximum kinetic energy of electronic emission was a linear function of the frequency (ν) of the light employed. In fact,

$$\tfrac{1}{2} mv^2 = h(\nu - \nu_0),$$

where $h\nu_0$ is the 'electron affinity', and is a measure of the loss of energy suffered by the electron in escaping from the interior of the atom. This equation, which is the basis of one of the most accurate methods for the determination of Planck's constant h, suggests that there is a light-frequency ν_0, characteristic of the metal on which the light falls, and such that, if the incident light has a frequency less than ν_0, no electron emission takes place.

The fact that a metal such as potassium is sensitive to ordinary light at once suggests its use in a cell in which the electronic current so produced may be measured, and its variation studied with variation of the incident light. Again, the photo-electric current may be amplified by valve circuits used outside the cell, or may be magnified within the cell by filling the cell with gas, applying a relatively large electric field and so producing ionisation by collision.

Obviously, constructional problems of no small difficulty at once present themselves, and, these problems solved, with the many applications of photo-electric cells, the question of standardisation arises. It is, for example, a matter of primary importance that the gas-filled cells now so largely used in connexion with talking films should be standardised as regards size, voltage, and terminal arrangements. This and allied matters are discussed in detail by Dr. Norman Campbell, while the problems of manufacture are very fully described in connexion with the thalofide cell (a cell sensitive to the infra-red, in which the active substance is oxidised thallium sulphide), barium photo-electric cells, sodium, and selenium cells.

Theoretical problems did not bulk largely in the discussion. Dr. Campbell described a theory of selective emission in which it is suggested that in selectively emitting surfaces an electro-negative element is universally present. Further, following a clue given by the recent work of Fowler and Wilson, the conditions for selective transmission are assumed to be fulfilled if the potential changes at the transmitting surface are such that a 'valley' of potential is formed between two 'peaks' so situated that the waves associated with the electrons are capable of forming stationary waves between the sides of the valley. Two investigations of valve-amplification of photo-electric currents complete the more important theoretical studies read during the discussion.

The papers presented may conveniently be grouped under the main headings, history and development, theory, manufacture, and applications. Naturally, the application of widest interest is to photometry, and it is not surprising that eleven out of the twenty-seven papers presented deal with various aspects of photometry. The problem is not easy. It has been well remarked of the human eye that "an instrument that will work with almost equal precision in illuminations differing in a ratio of ten thousand to one is not likely to distinguish easily small differences of illumination". Photo-electric methods are considerably more precise, but it must be carefully considered what that precision measures, in view of the fact that two lights, judged by the eye to be equal, will not be rated as equal by a photo-electric cell unless they have the same quality; and further, it may be debated whether high precision is worth while, when we remember that in problems of vision the eye is the final standard. However that may be, photo-electric photometry is coming into wide use, and the papers dealing with precision measurements in photometry, the comparison of lights of very small intensity, the photo-electric measurement of daylight and of under-sea illumination, photo-electric photometry in relation to photo-therapy, and spectro-photometry, form a most helpful contribution to the discussion of this important branch of the subject.

In the section dealing with measurements, attention may be directed to a description, by Mr. Eric Moss, of a very compact null electrostatic method, involving the use of the Lindemann electrometer, for the absolute measurement of the photo-electric current.

A particularly neat application of the photo-electric cell to the measurement of small angles was described and demonstrated by Dr. Perfect, in which an image of a narrow slit is focused on the razor-sharp edge of a steel prism and is thus divided into two components, the relative intensity of which varies with the position of the image of the slit. This relative intensity is measured by allowing the components to 'flicker' on a photo-electric cell. The amplified alternating photo-electric current is rectified by a commutator, and its magnitude measures the relative intensity required. In the experiment as shown displacements of the beam of light which forms the image of the slit are compensated by means of a hollow prism containing air, the internal pressure of which may be varied. It is possible by this arrangement to measure angles of less than 15″ with a probable error of the order of 0·05″.

The discussion of the papers provided an occasion for a lively duel concerning the relative merits of the selenium cell and the photo-electric cell. But a welcome innovation, that of demonstrations, during the tea interval, of the subjects of papers of experimental interest, gave an opportunity, of which most of the members of the audience made full use, for that informal interchange of ideas which is, perhaps, one of the most valuable features of a discussion. This apart, the experimental illustrations, which included an exhibit of photo-electric cells of the type developed by Prof. Lindemann, and a demonstration by Prof. Thirring, of Vienna, made all the difference, for one hearer at least, between vague and vivid memories of a very valuable discussion.

ALLAN FERGUSON.

New Recording Anemometers.

WE have received a communication from Prof. W. W. Shoulejkin, of the Institute of Physics and Biophysics of Moscow, giving particulars of apparatus which he has designed for automatic measurement of the two following quantities :

(1) The amount of air that passes in a given interval of time across a unit of area normal to the instantaneous flow of the wind. This is a modification of the ordinary Robinson anemometer, arranged so that a paper tape is unrolled by an amount dependent upon the flow required.

(2) The instantaneous components of unit wind velocity in any two horizontal directions at right angles, or, in other words, the values of cos θ and sin θ, where θ is the angle between the direction of the wind and any fixed horizontal datum line, for example, the tangent to the coast line at a seaside place.

No special difficulty appears to have been attached to the designing of suitable link mechanism for achieving these ends, and it is stated that the apparatus is not costly to produce. A specimen has been supplied to the hydrophysical station of the above-mentioned

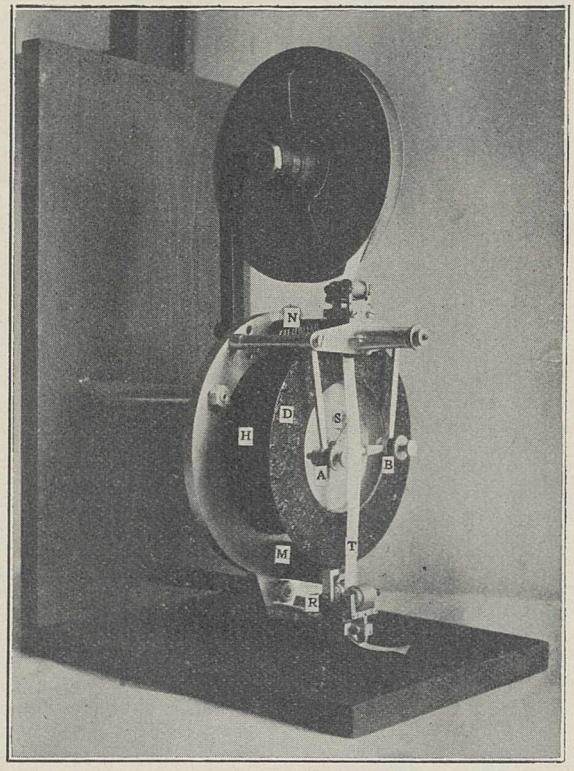

FIG. 1.

institute at Kaziveli (Crimea) for use in solving problems connected with the transference of heat and water vapour from the Black Sea to the adjacent land.

Another use suggested is for determination of the mean vector speed and direction of the wind at any place. In this case the axis of reference will be the east-west or south-north line.

The mechanism for achieving item (1) above is shown in Fig. 1. R is a ratchet wheel, and M an electromagnet. Every time that the cups of the anemometer complete one revolution, they complete an electrical circuit which brings this electromagnet into operation, and the latter turns the ratchet wheel

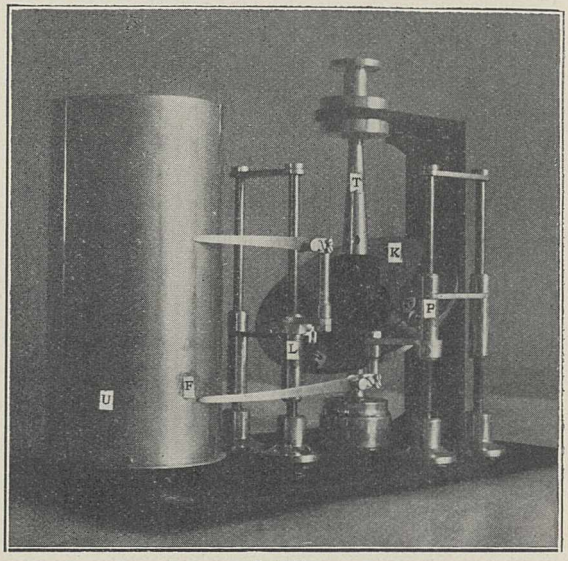

FIG. 2.

forwards by one tooth ; this causes a definite length of the tape T to be unrolled. D is a disc which bears twelve rubber zeros and twelve rubber dots on its face, equally spaced around the axis. The disc D is turned by the hour hand of a clock, so that every half-hour a zero or dot comes opposite to the tape. The minute hand S of the clock completes an electric circuit through screw A or screw B every time that this happens, and by this means another electromagnet is bought into action which draws forward the iron disc H and makes a zero or dot on the tape. In this way the run of wind for each half-hour can be measured on the tape.

The mechanism for achieving item (2) is shown in Fig. 2. T is the axis of a wind vane to which is rigidly attached an inclined disc K. The changes in the direction of the wind therefore cause K to revolve in a skew manner.

A roller attached to a sliding piece P conveys the simple harmonic movement in the vertical of the upper surface of the disc K near to P to a pen arm (F) linked with P, this movement being recorded on a chart attached to the drum U, which is turned by clockwork. In a similar manner, a second pen conveys the vertical movements of the disc at a point 90° from P through the agency of the sliding piece L. Now the difference in phase of 90° ensures that if the apparatus is so set that the displacements of F are proportional to the cosine between the direction indicated by the vane and the axis of reference (for example, the coast line), then the second pen will record the sine of that angle.

Atlantic and Pacific Land-Bridges.[1]

THE value of zoogeography as the pathfinder for geology is being more widely recognised. Dr. von Ihering summarises in this paper some of the conclusions from his life's study of the biological relations of South America to the history of the Atlantic and Pacific Oceans. He agrees in general with the conclusions put forward in 1929 by Prof. J. W. Gregory (see NATURE, April 20, 1929, p. 622) in the presidential address to the Geological Society on the "History of the Atlantic". Dr. von Ihering considers that the North and the South Atlantic were separated until the Miocene period by land that extended from West

Africa to the Antilles and South America. South of that land there was some connexion between the seas of Egypt and South Africa. The faunas of the North and the South Atlantic first intermingled in the Upper Miocene period.

The argument for the separation of South America and Africa by drift based on the shape of South America is invalid, as that shape was developed only in the Middle Quaternary. Previously the South Atlantic was a warm sea, and mangroves lived as far south as the Rio Negro: earth-movements then admitted a cold current, and the mangroves were driven 12° northwards, the change of climate exterminating the great Argentine Edentates.

The Pacific Basin in Upper Cretaceous time was traversed by a land for which is suggested the name 'Archipacifis'. Its eastern part extended along western North America as Schuchertland and along South America as Burckhardtland. The three sections were each a centre of mammalian development. The *Notostylops* fauna and the Dakota flora reached Patagonia by way of Archipacifis. The first immigration was earlier than the advent of Creodonts.

Archigalenis is a remnant of Archipacifis, and was the only Kainozoic trans-Pacific land-bridge: it lasted until the end of the Miocene period. To land west of America was due the range of the American Edentates, the intermingling in Patagonia of the northern and southern floras, and the occurrence in Mexico of an outlier of the southern crayfish and their parasites.

The view that the bears reached South America by Miocene time cannot be maintained, as it is based on fossils from the Pampas Formation having been accepted as from the Entrerios Beds. The isolation of Patagonia from Brazil until the Middle Miocene is now proved by deep bores under the pampas.

A land connexion across the southern Pacific between Australia and Patagonia is shown by, among other evidence, that of *Prothylacinus*, which, with its eight incisors, is a carnivorous marsupial, and not a Creodont.

[1] Substance of a paper by the late Dr H. von Ihering on "Land-Bridges across the Atlantic and Pacific Oceans during the Kainozoic Era" communicated by Prof. J. W. Gregory to the Geological Society of London on June 11.

Technical Teachers in Conference.

THE twenty-first annual conference of the Association of Teachers in Technical Institutions was held at Brighton during Whitsuntide, when the retiring president, Mr. A. E. Evans (Battersea Polytechnic) installed Mr. H. A. Norman (Headmaster, Junior Technical School, Bury) as president for the coming year.

Delivering his presidential address, Mr. Norman commented upon changes in industry and education. It is not yet fully realised, he said, that a provision of technical education which suits an industrial system of small manufacturers and operations carried out by large skilled labour forces does not meet the needs of a changing system in which industry is organised in larger units and in which a more highly trained skill is necessary in a smaller body of workers. Among the steps which are being taken to meet the problems presented by this change he indicated the work of the Emmott, Malcolm, and Balfour committees which dealt with problems of education and industry, the series of inquiries, memoranda, and reports which are being steadily made by the Board of Education, and the government committees on salesmanship and engineering. He specially stressed two reports on local areas, Yorkshire and the West Midlands metal-working area.

Surveying the activities of the A.T.T.I., the president insisted that they are not concerned alone with problems of industry and technical education. A well-balanced system of education needs co-ordination of all its branches. It is to be expected, therefore, that teachers' associations should form joint committees to examine mutual problems. Such joint committees (for example, the Joint Six Committee of the N.U.T., four secondary associations, and the A.T.T.I.) are attempting to frame policies and to make decisions which affect the whole teaching world. They are acquiring a status which suggests they will be able to take other steps which may be desirable. Recently, it is true, when questions of detail were discussed, the need for independent action by some of the constituent associations had appeared—a fact which points to the conclusion that attempts to force unity will tend to perpetuate differences rather than to promote common action.

Mr. Norman made a special plea for junior technical schools in connexion with the raising of the school leaving age. It is clear, he said, that the change will profoundly affect work which falls within the province of the A.T.T.I. Technical institutions will expect, as a result of the advance in staffing and equipment which the raising of the age should involve, that students will enter on technological studies much better prepared than is now the case. From the experience of the junior technical school the question of staffing is of vast importance, since the success of any scheme depends ultimately on the teacher. The raising of the leaving age will keep within the ranks of full-time pupils those who are growing from childhood to adolescence; for all pupils a large proportion of this period of rapid growth and emotional change will, in future, be accomplished during school life. What steps are being taken to meet the new facts and conditions? Endless heavy and monotonous toil such as is often suffered by children who enter industry at twelve and thirteen years of age is not part of the birthright of any child; but neither is an education which does not satisfy because it fails to use the ambition of boys and girls to be up and doing in the world. There is a part in all of us which is practical rather than wholly bookish; there are children whose whole nature can best be developed by reference to those practical instincts. The admitted success of the junior technical school has been due to the fact that, while it does not neglect the academic side, a good proportion of its time is spent in pursuits which involve practical work in rooms other than class rooms. Its staff, too, includes teachers who are themselves directly acquainted with the conditions of life which face pupils not only in industry and commerce, but also in the greater part of the circumstances arising therefrom which go to make up the life of a young person.

Mr. Norman insisted that the A.T.T.I. could not wholly discharge its function through the media of its local and national activities. The advance of science is slowly breaking down international barriers; certain international problems cannot, therefore, be avoided. He was happy, however, to be able to report work done in connexion with the interchange of teachers through the English-speaking Union, and the share which the association has taken in the work of a committee of local education authorities, teachers' associations, and the League of Nations Union, which,

with regard to the inclusion of League of Nations teaching in schools, has recently presented its report to the President of the Board of Education.

Among the resolutions dealt with by the Conference was one which urged the necessity for connecting links between government departments concerned with education schemes (for example, Ministries of Health, Labour, Agriculture, and Education); and one which pleaded for legislation recognising for purposes of superannuation all full-time service in university colleges, prior to the introduction of the present university superannuation scheme, as service in a technical institution.

University and Educational Intelligence.

LONDON.—Applications are invited for the Laura de Saliceto studentship for the advancement of cancer research. The studentship will be tenable for not less than two years, and the annual value £150. The latest date for the receipt of applications by the Academic Registrar, University of London, South Kensington, S.W.7, is July 1.

MANCHESTER.—A limited number of research scholarships in technology will be awarded in July next by the Manchester Municipal College of Technology. The value of each will not exceed £100. Research may be undertaken in any of the following departments: mechanical engineering, electrical engineering, municipal engineering, applied chemistry, textile industries, photographic technology, printing, and industrial administration. There are also scholarships of a yearly value of not more than £100 each, to part-time students of the College and others who are Manchester ratepayers or sons or daughters of Manchester ratepayers. Applications must reach the Registrar on June 27 at latest.

OXFORD.—In proposing the acceptance of the offer by Sir William Morris to place the Radcliffe Observatory site and buildings in the hands of trustees for the benefit of the Radcliffe Infirmary and the Medical School, Professor G. Dreyer directed attention to the unique character of the gift, spoke of the closer connexion between the University and the Infirmary which it would favour, and pointed out that it would provide room for the extension of the Infirmary, and for the development of post-graduate teaching.

The report just published of the Delegates of the University Museum announces that a scheme has been put into operation whereby details of certain vacancies requiring candidates with scientific training can be brought to the notice of the teaching staffs of the Museum departments.

The reports of the various scientific departments contain lists of research work published during the year, and accounts of accessions to the collections. These are especially copious in the case of the Pitt-Rivers Museum and the department of the Hope professor of zoology. Noteworthy among the former are a collection from the Bororó tribe of Brazil, made by Mr. George M. Dyott during his expedition in search of traces of the late Col. Fawcett, and a very remarkable series of wooden objects found in a cave in Tanganyika Territory; among the latter a fine series of Paraguayan butterflies presented by the late Dr. Charles Hose, a great collection of ants made by Mr. W. Cecil Crawley, a large number of Coleoptera from Windsor Forest given by Mr. Horace Donisthorpe, and a very full collection of British Lepidoptera by Dr. Nevil Sidgwick. This collection, part of which was made in the company of the late Mr. Arthur Sidgwick, contains a specimen of the North American *Danaida plexippus* caught at Lyme Regis in 1886.

A SCHOLARSHIP of the value of £100 for post-graduate research on wool has been instituted by the Weavers' Company. The research will be carried out in the laboratories of the Wool Industries Research Association. Applications should be sent not later than June 30 to the Secretary, Wool Industries Research Association, Torridon, Headingley, Leeds.

FROM the Imperial College of Tropical Agriculture, Trinidad, we have received a pamphlet containing a prospectus for 1930–31, the principal's report for 1928–29, and a register of staff and students. Courses are offered in agriculture, botany, chemistry and soil science, economics, mycology and bacteriology, tropical sanitation and hygiene, technology (chemical machinery, sugar technology, colloid science, physical chemistry, field and factory control), veterinary science, zoology, and entomology. A diploma course covering three years, a one-year course, refresher courses, and various post-graduate courses are provided. Fifty-five students were in residence last year, including twenty-seven graduates. The instructional staff numbered sixteen. In addition to numerous shorter notes and articles in the college journal, *Tropical Agriculture* (6*d*. monthly), twenty-one scientific papers were published during the year. Research is, in the main, concentrated, so far as concerns long-range investigations, on four crops, namely, sugar-cane, bananas, cacao, and limes. The plant includes a sugar-cane factory in which more than a thousand tons of cane were dealt with during the year.

Historic Natural Events.

June 23, 1783. Severe Frost.—Great damage was caused in Britain by a severe frost. Trees and fruit crops suffered badly, and also barley, oats, and rye. Ice a quarter of an inch thick was formed on tubs of water.

June 23, 1783. Dust Haze.—Gilbert White, in the "Natural History of Selborne", describes a peculiar haze or smoky fog which prevailed for many weeks in Britain and many parts of Europe on June 23–July 20, "during which period the wind varied to every quarter, without making any alteration in the air. The sun, at noon, looked as blank as a clouded moon, and shed a rust-coloured ferruginous light on the ground and floors of rooms, but was particularly lurid and blood-coloured at rising and setting. All the time, the heat was so intense that butchers' meat could hardly be eaten the day after it was killed; and flies swarmed so in the lanes and hedges that they rendered the horses half-frantic and riding irksome." The haze was undoubtedly due to volcanic dust from the eruption of Asama.

June 23, 1921. Thunderstorm and Flood.—The city of T'ung Chuan, in the province of Sz Chuan, in the interior of China, was visited by a severe thunderstorm which began at 1 A.M. and continued for twelve hours. During that time the rainfall amounted to 7·45 in. The level ground surrounding the city was flooded knee deep and corn was beaten down everywhere. The water entered the west gate, destroying many huts, and even some more solidly built houses fell down. Several people were drowned and many others rendered homeless. Two soldiers were struck by lightning and killed, others were rendered speechless. The Chinese said that they had not experienced such a storm for many years, and that it occurred because a dragon had been stolen from one of the temples outside the west gate.

June 24, 1034. Frost.—The Anglo-Saxon Chronicle records that "On Midsummer Day there was such a vehement frost, that the corn and other fruits of the

earth were blasted and killed, so that thereupon followed a great dearth in all the country."

June 24, 1897. Hailstorms.—The morning was very hot in England, and during the afternoon a series of violent thunderstorms developed at many widely separated localities. The greatest damage was done by a storm which crossed Middlesex and continued to Colchester in Essex, accompanied by violent winds and heavy hail, the stones being described as "as big as hens' eggs". The storm played havoc with the Diamond Jubilee decorations, broke thousands of panes of glass, smashed tiles, blew down chimneys and trees, ruined crops, and killed thousands of birds. There was great distress among the farmers in Essex, for there had not been a bad hailstorm for some years, and many of them had given up insuring against hail; the Lord Mayor of London opened a relief fund for the benefit of the sufferers.

June 25, 1545. Thunderstorm.—A great tempest occurred in Derbyshire, in which trees were overturned and churches, chapels, and houses unroofed. In Lancashire hailstones fell, said to be as big as a man's foot.

June 28, 1788. "The Midsummer Flood."—Whistlecraft, in "Rural Gleanings", states that the most remarkable rain ever known in northern Suffolk in June, "came down in awful torrents for some hours, until it caused the greatest inundation ever recorded in these parts. It has ever afterwards been called 'The Midsummer Flood'."

June 28–July 4, 1901. Heat Wave.—A spell of uniformly high temperature produced more serious effects in New York than had ever been experienced before. Even at night the thermometer rarely fell below 80° F., and the air was very humid. The asphalt with which the streets were paved softened with the heat, and the wheels of vehicles ploughed deep ruts in the roadways. Outdoor work was practically suspended, and even the Stock Exchanges in New York and Boston were closed. 150,000 people abandoned New York city, and thousands more slept in the public parks, which were kept open at night for that purpose. The hospitals were overcrowded with cases of heat prostration, while several hundred people and more than a thousand horses died from heat stroke.

June 28, 1917. Heavy Rain.—A depression passed along the English Channel, and very heavy rain fell over Somerset. At Sexey's School, Bruton, the amount measured was 9·56 in., a large part of which fell between 11 P.M. on June 28 and 1 A.M. on June 29. This is the heaviest fall in twenty-four hours on record in the British Isles. At King's School, Bruton, the amount was 8·48 in. It is estimated that during this storm 525,000 million gallons, or 2340 million tons of water fell in England and Wales. A great volume of water flowed along the valley of the Brue towards Burnham. At Bruton the valley narrows, and the town bridge confines the river still further, and here the water, unable to pass, flooded the low-lying parts of the town, doing much damage.

June 28, 1928. Heavy Rain.—Continuous heavy rain fell over the mountains of North Wales during strong south-westerly winds, the total reaching 7·77 in. at Blaenau Festiniog in Merioneth. The rainfall was largely due to the mountains, but an analysis of the weather charts showed that the winds were derived from two separate sources, a relatively cool current from the northern North Atlantic and a warmer current from farther south. These two currents were brought side by side, and it is probable that the cool current spread sideways under the warmer and moister air, raising it steadily and continuously throughout the day, and so greatly increasing the rainfall.

Societies and Academies.

LONDON.

Linnean Society, May 15.—H. R. Hewer: Studies in colour-changes in fish (Pt. 5). The colour-patterns in certain flat-fish, and their relation to the environment. Microscopical examination of the chromatophores, which form the basis of the colour-patterns, shows that the spots occurring on the upper side of the body may be divided up into groups according to their characters, such as distribution, size, and constituent chromatophores. These groups constitute the 'patterns', and they act as distinct entities, all the spots belonging to any particular pattern reacting in the same manner to any one stimulus. The constitution of any given type of spot is remarkably constant with a species. Among the fish examined, those having the greatest number and complexity of colour-patterns and therefore possessing the machinery for the largest range of adaptation, are the turbot (*Rhombus maximus*) and the brill (*R. lævis*), which are noted for their habit of moving over considerable areas. A study of the constitution of the spots in young forms in closely related species has demonstrated a series of stages of complexity approximating to the lines along which evolution has probably taken place.—E. M. Delf: The release of oogonia in the Fucaceæ. The first species considered was of *Bifurcaria brassiciforme*, one of the Fucaceæ common on the shores of the Cape Peninsula. Comparison was then made with other genera of intertidal habitats such as *Fucus*, which is habitually exposed during the fall of the tide and *Sargassum* and *Cystophyllum*, which are intertidal but constantly covered even at low spring tides in most localities.

Geological Society, May 28.—H. H. Swinnerton: The post-Glacial deposits of the Lincolnshire coast. The clays which underlie the Lincolnshire marshland crop out between the tide-lines along the coast, and many temporary exposures have been examined in the vicinity of Chapel St. Leonards and Ingoldmells. These deposits lie upon an uneven floor of boulder-clay, and may be divided into Lower, Middle, and Upper Series, separated by well-defined erosion-surfaces. The lower series consists of peat enclosing remains of oak, alder, and birch. It was formed during Neolithic times, when the area must have been at least 20 feet above its present level. The middle series consists almost entirely of purple and grey buttery clays, and rests upon an eroded surface of boulder-clay and peat. It is usually 7 feet thick, and is divisible into lower and upper portions by a marked difference in the contained flora. The upper series consists of grey, purple, and black sloppy clays, with numerous *Scrobicularia* and *Cardium* in their lowest portions. The thickness varies from 18 to 9 feet. There is evidence that this series was formed after the Roman occupation. The character and contents of these post-Glacial deposits indicate deposition under estuarine conditions, associated with the presence of an off-shore barrier, probably breached during the thirteenth and fourteenth centuries, thus establishing the present exposed condition of the coast.

Mineralogical Society, June 3.—L. J. Spencer: A new meteoric iron from Piedade do Bagre, Minas Geraes, Brazil. This mass, found in 1922 and weighing 130 lb., is of special interest in showing on one corner a well-marked octahedral fracture, and on a polished and etched section taken from this portion of the mass a complex system of very distinct Neumann lines. Neumann lines are twin-lamellæ

produced by gliding on planes of the icositetrahedron (211); and it is believed that these, as well as the octahedral fracture, were developed by the shock of impact when the meteorite fell with its corner on hard rock.—**Miss Jessie M. Sweet**: Notes on British barytes. It is shown that the localities of barytes and fluorite follow the outcrop of the Whin Sill in the north of England and of the toadstones in Derbyshire. Attention is directed to a change in colour from yellow to blue in some barytes crystals from Mowbray mine, Frizington, Cumberland, on exposure to the light. Zoned crystals and some rare crystal-forms are described.—**M. H. Hey**: On face- and zone-symbols referred to hexagonal axes: The three hexagonal zone-symbols for any one zone referred to the Bravais axial system and obtained by cross multiplication of face-symbols dropping the first, second, or third index, all obey the Weiss zone-law and, when added together, applying a factor of 2/3 for the fourth index, yield a four index zone-symbol identical with that obtained for the zone from the gnomonic or linear projection. This four index zone-symbol also obeys the Weiss zone-law if a factor of 3/2 be applied to the unique index when operating upon the face-symbols of a face in the zone. General expressions are obtained for passing from any one of the three index zone-symbols to the other two and also to the four index symbol and vice-versa.—**L. J. Spencer**: Biographical notices of mineralogists recently deceased (fourth series): For the past three years thirty-eight biographies are included. Ages range from thirty-two to ninety-one years, with an average of sixty-eight years. Prominent are P. Groth and G. Tschermak, who both died in 1927.—**F. Walker**: A tholeiitic phase of the quartz-dolerite magma of central Scotland. The tholeiites of Dalmeny and Kinkell are described and shown to contain chlorophæite. It is demonstrated by means of analyses and refractive index determinations that the residual glass is of acid composition in both rocks: a conclusion which does not support some of the ideas of Dr. C. N. Fenner on the crystallisation of basalt.—**M. H. Hey**: On pink epsomites and fauserite. A supposed specimen of the latter in the British Museum proves to be pink epsomite. Fauserite is a doubtful species.

Physical Society, June 13.—**E. J. Williams**: (1) The induction of electromotive forces in a moving liquid by a magnetic field, and their application to the investigation of the flow of liquids. A magnetic field induces electromotive forces in a moving liquid and by investigation of the e.m.f.'s produced by a known magnetic field it is possible to obtain information about the distribution of velocities in the liquid. Potential differences of the order of 10^{-4}-10^{-3} volts, set up by a magnetic field in an aqueous solution of copper sulphate, can be satisfactorily measured. (2) The motion of a liquid in an enclosed space. The increase of resistance of a column of mercury in a magnetic field, found in experiments on this effect, is due to the internal motion of the liquid produced by the action of the ampère forces between the magnetic field and the electric current traversing the mercury. E.m.f.'s so small as 10^{-6} to 10^{-7} volts, induced by a magnetic field in moving mercury, can be accurately measured.—**E. V. Appleton**: Some notes on wireless methods of investigating the electrical structure of the upper atmosphere (2). The relations between the optical and equivalent paths of waves deviated by the upper atmosphere and between the rates at which these quantities may vary with time are investigated theoretically, and, from the results of experiments carried out to test these relations, deductions are made concerning (*a*) the existence of more than one ionised region in the upper atmosphere, (*b*) the possible influence of magnetic storms on atmospheric ionisation, (*c*) the gradient of ionisation in the upper atmosphere and its alteration under solar influence at sunrise, and (*d*) the actual height reached by waves deviated in the upper atmosphere.—**C. R. Darling**: A simple method of showing the modes of vibration of a wire. The wire is heated with alternating electric current and its tension varied; the various modes are easily observable owing to the luminosity of the wire.

DUBLIN.

Royal Irish Academy, May 26.—**R. W. Ditchburn**: Notes on resolving power. The nature of the Rayleigh conception of resolving power and its range of application are discussed. We may usefully distinguish three stages in resolution; first, when inhomogeneity may be detected; second, when the number and wave-length separation of the components can be distinguished; and third, complete resolution when both wave-lengths and intensities can be accurately measured. The Rayleigh criterion corresponds roughly with the second stage. The paper includes sections dealing with (*a*) the difference between visual and photographic photometric resolution; (*b*) the difference between resolution of emission and absorption lines; (*c*) the resolution of lines of unequal intensity; (*d*) the resolution of lines of finite breadth. The fundamental conditions affecting the practical efficiency of methods for wave-length resolution are considered.

EDINBURGH.

Royal Society, May 26.—**Niels Bohr**: Philosophical aspects of atomic theory: Recent experimental and theoretical studies of physical phenomena have revealed a limitation in our ordinary concepts of natural philosophy as regards the description of the behaviour of single atoms. This limitation is an immediate consequence of the discovery of the elementary quantum of action, which excludes a simple distinction between the atomic phenomena and the observation, since any observation necessarily involves a finite change in the course of the phenomena. This circumstance prevents a pictorial description of atomic phenomena and allows us to apply physical concepts only in connexion with probability considerations. The new situation in physics with which we are thus confronted presents a remarkable analogy with situations with which we are familiar from studies in biology and psychology.

PARIS.

Academy of Sciences, May 5.—**E. Goursat**: The singular multiplicities of systems in involution.—**Georges Perrier**: The Rohan-Chabot expedition (Angola, Zambezi). This was an expedition organised privately by Comte Jacques de Rohan-Chabot. A résumé is given of the geographical, magnetic, and meteorological observations.—**Ch. Achard** and **M. Enachesco**: The variations, spontaneous or provoked, of the distribution of chlorine between the serum and the blood corpuscles in disease. The results obtained broadly confirm those previously described concerning the variations of the chlorine and of the acid-base equilibrium in morbid states, particularly in cyclic diseases.—**Paul Delens**: The analytical representations of cycles of space.—**F. Campus**: Correction of the mean fibre of the arches of barrages.—**B. Galerkin**: Contribution to the general solution of the problem of the theory of elasticity in the case of three dimensions.—**Benjamin Jekhowsky**: The calculation of the dimensions of the orbit of the new trans-Neptunian celestial body.—**M. and Mme. Henri Mineur**: The

rotation of the local star cluster and the galaxy.—**Jean Peltier**: The search for defects in ferromagnetic test-pieces. By the use of a four-valve amplifier and a loud speaker, superficial faults of one cubic millimetre produce sounds audible all over the laboratory: at present the method is limited by the fact that the penetration is only some millimetres into the test specimen, but this defect may be overcome by the use of more powerful magnetic fields.—**E. Rinck**: The equilibrium, in the fused state, between sodium, potassium, and their fluorides. The law of mass action $(Na)(KF)/(K)(NaF)=c$ has been verified, c being a constant of about 0·29.—**Mlle. Amagat**: The action of sodium amide on some alkyl bromides. Bromides of the type $(C_6H_5)R\,.\,CH\,.\,CH_2Br$ treated with sodium amide in xylene solution give almost exclusively the symmetrical hydrocarbons $C_6H_5.CH=CH.R$.—**Ch. Courtot and J. Pierron**: Contribution to the study of alcohols unsaturated in the β *or* γ positions.—**Henri Besairie**: The stratigraphy of the secondary and tertiary formations of the province of Betioky (south-west Madagascar).—**Jacques de Lapparent**: The mineralogical and chemical behaviour of the alteration products of the gneiss of the French central massif, before the establishment of the sedimentary deposits of the Oligocene.—**C. and M. Schlumberger**: The electromagnetic determination of the direction of sedimentary deposits.—**Mlle. Lucienne George**: *Ephedra nebrodensis* of the north of Africa. An account of the modifications of the plant due to the change in medium, more especially the intense insolation.—**A. Guillaume**: The migration of the alkaloids in the course of the germination of seeds and the formation of the embryos: researches on *Lupinus mutabilis*, var. *Cruiskanks*.—**Antonin Nemec**: A rapid method for the determination of the effect of phosphatic manures on the yield of cultures. The method is based on the fact that the proportion of ferric oxide in a soil affects the action of a phosphatic manure.—**Gordon H. Scott**: The localisation of the mineral constituents in the cellular nuclei of acini and the excretory ducts of the salivary glands.—**A. Policard and Mlle. V. Mouriquand**: The tissue reactions provoked by the intraconjunctival injection of particles of asbestos. An experimental study of pulmonary asbestosis.—**J. Abelous and R. Argaud**: The secretory activity of the nuclei in the suprarenal adenomes.—**Mlle. Andrée Courtois**: The proportions and variations of the phosphorus in the course of nymphosis of some Lepidoptera.—**Edouard Chatton, André Lwoff, and Mme. Marguerite Lwoff**: The Phoretophrya, ciliated Fœttingeriideæ, hyperparasites of the Gymnodinioides, parasite Fœttingeriideæ of the Crustacea.

PRAGUE.

Czech (Bohemian) Academy of Sciences and Arts (Second-class, Natural Science and Medicine), April 4.—**L. Seifert**: A geometrical theory of the general surface of the third order.—**E. Votoček, F. Valentin, F. Rac**: Studies in the rhamnose series. The molecule of water in rhamnose, $C_6H_{12}O_5\,.\,H_2O_1$, is not constitutive but crystalline, since the combination of *d*- and *l*-rhamnose in aqueous alcohol yields anhydrous racemic rhamnose, $(C_6H_{12}O_5)_2$.—**J. Klima**: The determination of the order and decomposition of lines of striction of algebraic ruled surfaces.—**J. Kokta**: Some physico-chemical properties of opals and their relation to artificial amorphous silicic acids.—**B. Gosman**: Reduction of sulphurous acid at the dropping mercury cathode. Sulphurous acid is reversibly reduced at about $-0{\cdot}2$ v. to hydrosulphurous acid, only undissociated molecules being capable of reduction. Normal sulphites are not reducible.—**J. H. Krepelka**: The atomic weight of arsenic. (I. The analysis of arsenic trichloride.) The mean value derived from thirteen determinations of the ratios $AsCl_3 : 3Ag$ and $AsCl_3 : 3AgCl$ is $As = 74{\cdot}936 \pm 0{\cdot}001$, if silver is taken as 107·88 and chlorine as 35·458. This figure agrees closely with that of Aston (74·934) derived from the mass spectrum.—**O. Quadrat, T. Korecky**: Complex organic compounds with aluminium hydroxide.

Official Publications Received.

BRITISH.

Department of Scientific and Industrial Research. Building Research Abstracts. Vol. 3 (New Series), No. 4, April. Abstracts Nos. 671-901. Pp. 113-153. (London: H.M. Stationery Office.) 9*d*. net.

Commonwealth of Australia: Council for Scientific and Industrial Research. Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Edited by Ernest R. Pitt. Pp. xxiv+1208. (Melbourne: H. J. Green.) 10*s*.

A Short Account of the Work of the Indian Lac Research Institute. Pp. 23. (Nankum, Ranchi.)

Journal of the Indian Institute of Science. Vol. 13A, Part 5: Soil Survey of the Nalkantha District (Limbdi State) and its Significance. By C. V. Ramaswami Ayyar. Pp. 43-56. (Bangalore.) 1.8 rupees.

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 2: The Brazil Nut in Malaya. By J. Lambourne. Pp. 15+5 plates. (Kuala Lumpur.) 50 cents.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 25, 1929, No. 1. Pp. 313+29 plates. (Calcutta.) 49 units.

Armstrong College, Newcastle-upon-Tyne: Standing Committee for Research. Report, Session 1928-1929. Pp. 31. (Newcastle-upon-Tyne.)

Somaliland Agricultural and Geological Department. Annual Geological Report for 1929. Pp. 12. (London: The Crown Agents for the Colonies.) 2*s*.

Journal of the Royal Statistical Society. Vol. 93, Part 2. Pp. 183-341+xii. (London.) 7*s*. 6*d*.

Patents, Designs and Trade Marks. Forty-seventh Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices for the Year 1929. Pp. 24. (London: H.M. Stationery Office.) 4*d*. net.

Transactions and Proceedings of the New Zealand Institute. Vol. 60, Part 4, December 1929. Pp. iv+521-665. (Wellington, N.Z.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, May. Pp. 205-293+xl. (London.)

Institution of Chemical Engineers. Papers presented by Members at the World Engineering Congress, Tokio, October-November 1929. (Papers 277-284.) Pp. 100+12 plates. (London.) 10*s*. 6*d*.

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1930. Pp. 63+16 plates. (Edinburgh.)

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Ninth Annual General Meeting on May 29th, 1930. Pp. ii+80. (London.)

Ordnance Survey. Results of the Magnetic Observations made by the Ordnance Survey in England and Wales in 1928, and Preliminary Results (Declination only) of those made in Scotland in 1929. Pp. 7. (London: H.M. Stationery Office.) 1*s*. net.

Empire Marketing Board, May 1929 to May 1930. (E.M.B. 28.) Pp. 99. (London: H.M. Stationery Office.) 1*s*. net.

Department of the Interior: North West Territories and Yukon Branch. The North West Territories, 1930. By F. H. Kitts. Pp. 137. (Ottawa: F. A. Acland.)

Journal of the Chemical Society. May. Pp. vi + 905-1276 + xii. (London.)

The National Benzole Association. Seventh Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds. (Presented May 21st 1930.) Pp. iv+149+6 plates. (London.)

Australia. Third British Empire Forestry Conference, Australia and New Zealand, 1928. Proceedings. Pp. 309+viii. (Canberra: H. J. Green.)

FOREIGN.

University of Illinois Engineering Experiment Station. Bulletin No. 202: Laboratory Tests of Reinforced Concrete Arch Ribs. By Prof. Wilbur M. Wilson. Pp. 99. 55 cents. Circular No. 20: An Electrical Method for the Determination of the Dew-Point of Flue Gases. By Henry Fraser Johnstone. Pp. 22. 15 cents. (Urbana, Ill.)

United States Department of Agriculture. Circular No. 116: Calcium Arsenate Dusting as a Cause of Aphid Infestation. By J. W. Folsom and F. F. Bondy. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Svenska Linné-Sällskapets Årsskrift. Årgång 13, 1930. Pp. viii+190. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Studies in African Acrydiinae (Orthoptera, Acrididae). Part 1: Cladonotae, Scelimenae and Metrodorae. By James A. G. Rehn. Pp. 91-137+4 plates. (Philadelphia.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 23, Part 6: Synthese gerbender Stoffe, Teil 2. Von Prof. Dr. G. Grasser und K. Hirose. Pp. 189-223. (Tokyo: Maruzen Co., Ltd.)

U.S. Department of Commerce: Bureau of Standards. Miscellaneous Publication No. 108: Manufacture and Properties of a Cellulose Product (Maizolith) from Cornstalks and Corncobs. By C. E. Hartford. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 5, No. 1. Pp. 213+8 plates. (Tokyo and Sendai: Maruzen Co., Ltd.)

Kungl. Sjökarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1928. Pp. 33. Jordmagnetiska Publikationer, Nr. 7: Jordmagnetisk Översiktskarta över Sverige 1930 (Magnetic General Chart of Sweden 1930). Av Gustav S. Ljungdahl. Pp. 4. (Stockholm.)

Bulletins of the Pacific Scientific Fishery Research Station. Vol. 3, Part 1: Материалы по рыбам шантарского моря (Material about the Fishes of the Shantar Sea). By G. U. Lindberg and G. D. Dulkeit. (With Summary in English.) Pp. 139. 2r. 50k. Vol. 3, Part 2: К познанию донных сообществ шантарского моря (Upon the Bottom Communities of the Shantar Sea—S-W Okhotsk Sea). By I. Zachs. (With Summary in English.) Pp. 112. 1r. 90k. (Vladivostok.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 2: Über die Automorphismen einer endlichen zerlegbaren Gruppe. Von Kenjiro Shoda. Pp. 25-50. 0.60 yen. Section 3: Botany. Vol. 2, Part 3: Studies on the Structure of Japanese Species of Ranunculus. By Masao Kumazawa. Pp. 297-343. 1.00 yen. (Tokyo: Maruzen Co., Ltd.)

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1929. (Publication 3060.) Pp. iv+222. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution: United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. The Fishes of the Families Amiidae, Chandidae, Duleidae and Serranidae, obtained by the United States Bureau of Fisheries Steamer *Albatross* in 1907 to 1910, chiefly in the Philippine Islands and adjacent Seas. By Henry W. Fowler and Barton A. Bean. Pp. ix+334. (Washington, D.C.: Government Printing Office.) 60 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 4, No. 3 (R.P. Nos. 152-159). Pp. 329-459. 40 cents. Vol. 4, No. 4 (R.P. Nos. 160-166). Pp. 461-599. 40 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 156: Triangulation in Hawaii. By Hugh C. Mitchell. Pp. vi+240. 50 cents. Special Publication No. 160: Triangulation in Colorado (1927 Datum). By Oscar S. Adams. Pp. v+72. 15 cents. (Washington, D.C.: Government Printing Office.)

Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1927. Pp. iv+154. (Zinsen.)

National Research Council of Japan. Report No. 1, March 1922. Pp. iii+20. Report No. 2-3, April 1922–March 1924. Pp. iii+21-64. (Tokyo.)

Catalogues.

Liver Extract B.D.H. in the treatment of Pernicious Anæmia. Pp. 7. (London: The British Drug Houses, Ltd.)

Books and Prints arranged under the following headings: Private Presses and Special Editions, First Editions, Literature in General, with a selection of books about Books, Old Prints and Maps. (No. 450.) Pp. 32. (Cambridge: Bowes and Bowes.)

Diary of Societies.

FRIDAY, JUNE 20.

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting), at 10 A.M.—Papers by Dr. D. Crow, Dr. A. Brown Kelly, Dr. D. McKenzie, T. Neville, E. Watson-Williams, and others.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—A. J. Wrigley: Puerperal Infection by the Pathogenic Anaerobic Bacteria.—Dr. H. K. Griffiths: (*a*) A Lithopædion; (*b*) A Short Account of a Pregnancy in One Horn of a Bicornate Uterus.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District Meeting) (at Harpenden).

SATURDAY, JUNE 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND METALLURGY (Newcastle-upon-Tyne), at 2.30.—Prof. H. Louis: The Pitman's Yearly Bond.—J. T. Whetton: The Surveying of Bore-holes.—Discussion on Paper by G. E. Tansley on The Value of the Economiser in Present Day Boiler Installations.

MINING INSTITUTE OF SCOTLAND (in Mining Laboratories, Grassmarket, Edinburgh), at 3.—J. S. Carson: The Use of Iron and Steel for Underground Support.—C. McLuckie: The Detection of Inflammable Gases and Vapours.—Discussion on Paper by W. J. Skilling on Low Temperature Carbonisation.

PHYSIOLOGICAL SOCIETY (at University College).—Prof. L. Lapicque and others: Discussion on The Time Relations of Excitation and their Significance in Central Nervous Phenomena.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Norwich).

MONDAY, JUNE 23.

ROYAL GEOGRAPHICAL SOCIETY (Annual General Meeting) (at Æolian Hall), at 3.—Presentation of Gold Medals and Awards: President's Address: Annual Report of the Council: Election of President, Officers, and Council.

ROYAL IRISH ACADEMY (Dublin).

TUESDAY, JUNE 24.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Gossip Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.

LONDON CLINICAL SOCIETY (at London Temperance Hospital).—Sir Robert Armstrong-Jones: The Evolution of the Human Mind (Macalister Lecture).

WEDNESDAY, JUNE 25.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—J. E. Richey: The Geology of the Tertiary Igneous Complex of Ardnamurchan.

ROYAL SOCIETY OF ARTS.—Annual General Meeting.

THURSDAY, JUNE 26.

ROYAL SOCIETY, at 4.30.—Prof. A. V. Hill and P. S. Kupalov: The Vapour Pressure of Muscle.—Prof. A. V. Hill: The State of Water in Muscle and Blood and the Osmotic Behaviour of Muscle.—W. Sucksmith: The Gyromagnetic Effect for Paramagnetic Substances.—And other Papers.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—M. C. Johnson: The Effect of Photo-sensitised Mercury Vapour on the Walls of Silica Vacuum Tubes.—H. R. Nettleton and F. H. Llewellyn: A Sensitive Rotating Coil Magnetometer.—L. Hartshorn: The Frequency-errors of Rectifier Instruments of the Copper-oxide Type for A.C. Measurements.—D. S. Perfect: A Method of Eliminating the Effects of Magnetic Disturbances in Highly Sensitive Galvanometers.—*Papers to be read in title only*:—M. C. Marsh: The Thermal Insulating Properties of Fabrics.—W. Band: The Classical Quantum Theory and X-ray Excitation by Canal Rays and Alpha Particles.—A. T. McKay: Diffusion from an Infinite Plane Sheet Subject to a Surface Condition, with a Method of Application to Experimental Data.—S. Tolansky: Intensity Modifications in the Spectrum of Mercury.

MEDICO-LEGAL SOCIETY (Annual General Meeting) (at 11 Chandos Street, W.1), at 8.—Prof. J. S. Haldane: Carbon Monoxide Poisoning.

INSTITUTION OF MINING AND METALLURGY (at Geological Society).—Annual General Meeting.

FRIDAY, JUNE 27.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Nottingham).—Papers by Dr. M. Evans, Prof. G. Guida, Dr. Densham, and L. Yates.

SATURDAY, JUNE 28.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section) (at St. Vincent's Orthopædic Hospital, Eastcote, near Pinner), at 3.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Nottingham).

CONGRESSES.

JUNE 21 TO 28.

ROYAL SANITARY INSTITUTE (at Margate).

Monday, June 23, at 3.—Lord Cornwallis: Inaugural Address.

Tuesday, June 24, at 10 A.M.—Meetings of Sections and Conferences.
A.—Preventive Medicine.
I.—Representatives of Sanitary Authorities.
V.—Engineers and Surveyors.
VI.—Sanitary Inspectors.
VII.—Health Visitors (including Personal and Domestic Hygiene).
At 8 P.M.—Dr. O. C. Bradley: Diseases of Domestic Animals from the Human Angle (Lecture).

Wednesday, June 25, at 10 A.M.—Meetings of Sections and Conferences.
A.—Preventive Medicine.
B.—Engineering and Architecture.
D.—Hygiene of Food.
VI.—Sanitary Inspectors.
VII.—Health Visitors (including Personal and Domestic Hygiene).

Thursday, June 26, at 10 A.M.—Meetings of Sections and Conferences.
B.—Engineering and Architecture.
C.—Maternity and Child Welfare (including School Hygiene).
F.—Veterinary Hygiene.
IV.—Medical Officers of Health.

Friday, June 27, at 10 A.M.—Meetings of Sections and Conferences.
C.—Maternity and Child Welfare (including School Hygiene).
E.—Hygiene in Industry.
F.—Veterinary Hygiene.
II.—Representatives of Port Sanitary Authorities.
III.—National Health Insurance Services.

JUNE 22 TO 28.

INTERNATIONAL CONGRESS OF MINING, METALLURGY, AND APPLIED GEOLOGY (at Liège).—In three sections: (*A*) Mining, including Reconnaissance and Preliminary Work, Modern Methods of Working Coal Mines, Metalliferous Deposits and Quarries, Generation and Utilisation of Energy, Extraction, Ventilation (Gas and Dust), and Mechanical Treatment of Ores and Coal; (*B*) Metallurgy, dealing with Blast-furnace Practice, Steel and Ferrous Alloys, Foundry Work, Non-ferrous Alloys and Fuels; (*C*) Applied Geology, covering Metals, Fuels, Hydrology, and Geophysical Prospecting.

JUNE 23 TO 27.

MUSEUMS ASSOCIATION (at Cardiff).

Tuesday, June 24 (at Park Hotel), at 10 A.M.—Sir Henry A. Miers: Presidential Address.
At 11.30 A.M.—Dr. O. Lehmann: Address.
At 3.30.—Dr. C. Fox: The National Museum of Wales.

Wednesday, June 25 (at Engineers' Institute), at 9.30 A.M.—Dr. C. Fox: The Affiliation of Museums—the Opportunities and Difficulties of the Parent Museum.
At 10.30 A.M.—W. C. Sprunt and Dr. T. W. Woodhead: Papers on Rural Science.
At 2.30.—Dr. F. J. North: Geology in Relation to the Small Museum.
At 3.15.—H. A. Hyde: Botany in Relation to the Small Museum.

SUMMER MEETING.

JUNE 21 TO 28.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Holland).