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Mr. Ormsby-Gore and Tropical Development.

THE attributes of a true research worker are high intellectual endowment, a desire for knowledge, a capacity for accurate observation and selection of relevant facts and data, a mind unbiased by preconceived ideas, sound judgment, and breadth of vision. We rarely associate such a combination of qualities with our politicians. Special pleading is the enemy of truth. Occasionally, however, even a politician may free himself from the shackles of political expediency, and put the general interest before self-interest, mankind before country, and country before party. To distil the essential wisdom from the heterogeneous ingredients of party controversy requires the courage of statesmanship, the penalty of which is not infrequently loss of office and political oblivion. For office is a party spoil.

These reflections savour of the platitudinous, but they are occasioned by reading the remarkable report (Cmd. 3235; London: H.M. Stationery Office) on his visit to Malaya, Ceylon, and Java, which the Parliamentary Under-Secretary of State for the Colonies, Mr. Ormsby-Gore, has just completed for presentation to Parliament. This is the fourth report of its kind, based on personal visits, for which Mr. Ormsby-Gore has been partly or solely responsible. In 1922 he accompanied his predecessor in office (Mr. Edward Wood, now Lord Irwin) to the West Indies and British Guiana. Two years later, Mr. J. H. Thomas, then Colonial Secretary, made him chairman of the Parliamentary Commission which visited East and Central Africa, and in 1926 he made a tour of the four British Colonies in West Africa. In the course of these tours alone, therefore, he has formed direct personal contact with the most of the dependencies the affairs of which fall within the scope of his ministerial responsibility. His personal acquaintance with the countries of the Empire does not end there, however. Before the War he visited South Africa and Rhodesia, and during the War he served in Egypt, later as intelligence officer in the Arab Bureau, and finally as Assistant Political Officer in Palestine. Probably no other minister has been able to bring to bear upon his task such comprehensive first-hand acquaintance with our non-self-governing dependencies and the mandated territories for which we are responsible.

Had such tours been made solely with the object of obtaining first-hand information for facilitating Mr. Ormsby-Gore's own work at the Colonial

Office, they would have been amply justified. Fortunately, he has a wider conception of his responsibilities. The knowledge he has gained he puts at the disposal of us all. He tells us freely what opinions he has formed, what modifications in policy he would advise. He gives us facts with strict impartiality. He expresses his opinions with no attempt at dexterous ambiguity, and certainly with no air of infallibility. On the contrary, he invites criticism, having first provided us with the necessary knowledge upon which to base it. These are the methods of the research worker, the methods which make for progress. They are certainly the only methods which will ensure that colonial development will proceed on right lines.

In each successive report on British colonies, Mr. Ormsby-Gore has advanced his claim to be considered a research worker, not, it is true, as an original investigator in a specialised branch of science, but in the wide and complex fields of human relationships and the relation of man to his environment. In these four reports on the colonies are set out with admirable clarity, completeness, and in due perspective, the multiplicity of problems confronting our colonial governments, together with what has been done towards their solution and what still remains to be done, what could have been done had our existing knowledge been properly brought to bear upon them, and problems which are likely to make the greatest demands on our research workers. Considered as a comprehensive whole, these reports constitute a great achievement. They can, with sincerity and truth, be described as a monumental and magnificent research.

In the introduction to his report on Malaya, Ceylon, and Java, the occasion of this review, Mr. Ormsby-Gore reminds us that "British possessions in the tropics are at widely different stages of development, but each and all have many problems in common, and each has something to learn from the experience and practice of others." Accordingly, in this, as in previous reports, he concentrates on particular features; for example, the state of agriculture and animal husbandry, public health, education, forestry, and transport, hoping that their study by the comparative method may reveal facts and suggestions which may prove useful to other colonies. A separate chapter is devoted to rubber; first, because it is the principal economic crop of Malaya; and, secondly, to comment on the results of the Stevenson scheme of restriction of output of this commodity. All these subjects possess a special interest for scientific workers, and in dealing with each of them Mr. Ormsby-Gore lays stress on the contributions which science has made or can be expected to make to the development of the services or industries with which they are related.

Not the least valuable parts of the report are those dealing with geographical, historical, and economic facts relating to the colonies. They cannot fail to interest anyone with the slightest desire for knowledge of conditions of tropical life. They are presented also in such a way as to fix outstanding facts in our minds. British Malaya, we are told, covers a total area a little less than that of England. Its total population is to-day probably about four millions. The Dutch Colony of Java, climatically resembling British Malaya, covering a smaller area, contains a slightly larger population than England, although most of the Javanese (the Handbook of the Netherlands East Indies gives the proportion as more than 70 per cent) are engaged in farming. Practically the whole of Java is under cultivation, whereas the greater part of the Malay peninsula is still virgin forest, and a large proportion of the food supplies for its inhabitants has to be imported. Yet, although the population density of Java is eleven times, and its actual population nearly ten times, that of British Malaya, its overseas trade is less than that of the British colony. For 1926 the imports of British Malaya were valued at £117,000,000, and the overseas exports at £147,000,000, the corresponding figures for Java being £72,000,000 and £131,000,000, all figures being exclusive of bullion and specie. "These remarkable totals [for British Malaya] exceed those of the total external trade of the whole of the rest of the Colonial dependencies put together. The value of exports per head of the population of British Malaya for the last two years has exceeded that of any other country in the world, and is higher even than the figure for New Zealand, which leads the self-governing Dominions in this respect."

Tin and rubber are the two factors determining this result for Malaya. "In 1927 nearly half the world's tin supply was mined in Malaya, and about 70 per cent of the supply of refined tin was shipped from the smelting works in Singapore and Penang." The net export of crude plantation rubber from Malaya in 1927 was 240,000 tons, representing more than 42 per cent of the total exports of rubber-producing countries. Soil fertility is the main factor determining the high population density of Java. The mountain region in Java consists entirely of volcanic rocks which disintegrate

rapidly in the warm, humid climate, and thereby enrich the soil. There are other contributory factors to be taken into account. The pirates of the Straits may have for centuries deflected Indian and Arab traders and settlers from Malaya to Java, while the efficiency of the Dutch colonial scientific and technical services in Java has resulted in vastly increased yields per acre and facilitated population increase. "The island of Java," says Mr. Ormsby-Gore, "affords the most remarkable example in the world to-day of the application of science to the development of the tropics." Obviously, neither piracy nor science can have been of great importance in comparison with the natural fertility of the soil in the determination of Java's high population density. If they had been, we should expect Sumatra to have a much higher density of population than British Malaya, whereas it is only slightly higher.

Nevertheless, what the Dutch have accomplished in Java by the application of science should provide much food for thought for all our colonial governments, and even India. The yield of rice per acre in Java is a little more than double that of British India. Last year (1928) Java expected to produce nearly three million tons of sugar from less than half a million acres of land. Since the establishment of the sugar industry in Java, about the middle of the last century, the yield per acre has been increased sixfold. Java is now the highest sugar producer per acre in the world, and owes its position to the application of plant genetics and soil science. The success of the cinchona (quinine) industry, a virtual monopoly in which is held by Java and Sumatra, has been due almost entirely to very strict scientific controls. The problems presented to the Irrigation Department in Java are some of the most difficult that have ever been presented to hydraulic engineers, Mr. Ormsby-Gore informs us, but they appear to have solved most of them. "As an investment it [the Irrigation Department] has repaid the Dutch East Indies very handsomely, and assuredly it is an outstanding example of the benefits which western science and technical skill can offer." In Buitenzorg, in Java, there are the famous tropical plant research station and a number of other institutions with which more than a hundred scientific workers are associated.

All research for the Dutch East Indies, however, is not centralised in the government research institute at Buitenzorg. The plan of special research institutes, the activities of which are centred in a particular crop, as advocated and put into effect by the Howards in India, has been in existence for a number of years in Java. "The pivot of the sugar industry in Java is the great sugar research-station at Pasoerean in East Java," the finest of its kind in the tropics. It has been supported entirely by the industry from its inception. Six other separate agricultural research stations, "proef-stations" as they are called, are maintained by the "Algemeen handbouw Syndicaat," or General Planters' Association, entirely by private subscription and voluntary levies. There are a Tea Research Station at Buitenzorg, staffed by nine European scientific workers; a Rubber Research Institute, also at Buitenzorg, also with nine workers; a coffee 'proof' station at Malang in East Java with eight; the Besoeki Proof Station at Djember, East Java, for tobacco, rubber, and coffee, with five Europeans; a quinine station at Tjinjiroean, in the Preanger Highlands, West Java; and a small general 'proof' station at Salatiga, near Samarang, Central Java.

Having been given the opportunity to make himself personally acquainted with the work of the Dutch administration and Dutch scientific workers in Java, noting that the greatest advances in the rubber-planting industry have been made by the United States Rubber Plantations and the A.V.R.O.S. Rubber Experimental Station in Sumatra, that Malaya has a handicap of ten years to make up in the scientific study of budgrafting and related problems of the rubber industry, that "the share of Malaya and Ceylon in total world exports of crude plantation rubber has fallen from 70 per cent in 1922 to 52 per cent in 1927, while the Dutch East Indies have increased their share from 25 per cent in 1922 to over 40 per cent in 1927," that "Malaya is behind Java in the use of wireless telegraphy and telephony, and its ordinary telephone system is not nearly so complete or far-reaching," Mr. Ormsby-Gore finds the cause in the British administration services. His attitude is reflected in the following comment on the recruitment of administrative officers for these colonies. "The examination seems still to attract in the main those who have specialised at the University in classics or pure mathematics. In the tropics, especially in tropical areas in process of rapid economic development, sound basic knowledge of natural science, biology as well as physics and chemistry, is of ever-increasing significance. The administrative officer has to fit in and co-operate with a large variety of technical officers, and . . . he should have some idea of the nature of the problems which confront the latter, who often looks upon him as a member of senior and pivotal service."

Neurology and Psychology.

Brain and Mind: or the Nervous System of Man. By Prof. R. J. A. Berry. Pp. xii+608. (New York: The Macmillan Co., 1928.) 31*s.* 6*d.* net.

IN the opening chapter of this interesting book is introduced the main theme of the whole volume: the neuronic arc is the basis of all nervous activity, whether the simple purposive reflex or even the human cerebral processes associated with thought, memory, and reasoning. Neuronic arcs are formed by chains of neurones or nerve cells functionally connected by synapses. The neurone is therefore the unit of nervous activity. This theme dominates the whole book, and it is in entire agreement with experimental findings.

For more than four hundred pages the morphology and development of the nervous system is dealt with in a systematic manner. Since this part of the book closely resembles most books on the anatomy of the nervous system, there is no need to consider it in detail. We doubt the utility of the continual publication, in books of this type, of much of the detailed anatomy of those parts of the nervous system concerning the function of which we are almost entirely ignorant, for it seems to cause a rather large break in the real matter in hand. There are numerous diagrams, some of which are very illustrative, and also short accounts of the physiology of the various parts described.

Unfortunately, Prof. Berry has not taken sufficient account of the more recent advances in the physiological knowledge of the nervous system. This is particularly evident in his chapter on the nerve impulse, where one finds his use of the term 'nerve energy' very vague and somewhat misleading. With our present conceptions of the physiology of the nervous system, such a term is better not used at all. We notice with approval that the histology of the cerebral cortex is dealt with clearly and fully. Prominence is given to the division by Watson of the cerebral cortex into three layers—infragranular, granular, and supragranular. The infragranular cortex is stated to be the brain of the animal and sexual instincts, the granular of reception and storage of impulses, and the supragranular of control, inhibition, and reason. While Bolton and Watson have adduced much evidence in support of this, we regard it as by no means proved, and, especially in the association areas, it seems possible that all parts of the cortex are concerned in the higher cerebral functions of control and reason. This division of the brain into layers of different function is perhaps no more absolute than the older division of it into functionally distinct areas.

In this and other places it is regrettable that Prof. Berry does not distinguish more clearly between facts and theories. The assignment of the function of 'storage of receptor impulses,' *i.e.* the basis of memory, to the neurones of the granular layer is interesting, but requires experimental support. Prof. Berry does not tell us how this storage occurs, and the idea seems opposed to our physiological knowledge. The usually accepted theory of memory is that a modification in the so-called synaptic resistance is produced by the passage of impulses, and this change may be of long duration if sufficiently intense. This can scarcely be termed a 'storage of impulses.' There are also speculations on the functions of other cells of the cortex. It is interesting to see the correlation of the developmental thickening of the cortex, and especially the myelination of the white matter with the data of Berry and Porteous on the increase in the cerebral capacity of the living child.

In the second part of the volume, Prof. Berry attacks the problem of the correlation of the morphology of the cerebral cortex with psychology. We agree with his insistence that psychology should be considered in relation to the structure of the brain, but we are not convinced that this has been successfully accomplished. For success to be attained, a much more precise knowledge of the detailed structure and function of the cortex is necessary, and that can only be obtained by years of patient research. The work of Pavlov on the cortex is of especial importance, yet it finds but scant mention in this book. Until our physiological knowledge is greatly added to, structure can be of little assistance in the elucidation of psychic processes. The difficulties are brought before us by the obscurities of many of the passages in some parts of this section.

On the psychological side Prof. Berry reminds one somewhat of McDougall, and his criticism of Freud is healthy and stimulating. For the most part it is just sound common-sense correlated with neurological knowledge. There is no doubt that we must agree with Prof. Berry's main theme—no neurone, no mind—and it is also certain that the individual who possesses less than a certain number of cortical neurones cannot be expected to be normal in behaviour. We are not convinced, however, that one can go further than this and say that intelligence is proportional to the number of cortical neurones. As yet, our knowledge of the functioning of the cortical neurones is not precise

enough to allow of anything except vague suggestions regarding their behaviour in mental processes, and, until our knowledge is more profound, mere numerical value is an unknown factor. As Prof. Berry himself states, the data from histological examination of cerebral cortices and from head measurement are only definite in extreme cases. One must bear in mind all those finer gradations in conduction from one neurone to another in the spinal cord, as found by Sherrington and others, and consider the possibility that in the cortex the gradations are even more delicate and more variable. In such a comparatively simple region of the nervous system as the spinal cord, it would be absolutely impossible to form any idea of the peculiarities of the reflexes elicited from it after the most careful macroscopic and microscopic examination. One must realise how crude our technique is. The index of chromatolysis on which the author places emphasis is by no means certain in interpretation. It seems unlikely that Nissl bodies are the source of the so-called nerve energy; most likely they are reserve food in the neurone.

Taking into account all these extreme difficulties, for there is no doubt that the human cerebral cortex is the most difficult problem man will ever face, one cannot help feeling that Prof. Berry has done well to get, in these days, so far as he has. In those interesting series of tests for mentally deficients, he has given us something of real value, for the high-grade ament is a very serious menace to society, and his early detection and control a matter of the greatest moment. The author's large experience of more than 15,000 cases places him in a position to speak authoritatively on that subject. He lays due stress on the fact that, while brain capacity is a useful test, it must only be used as an aid to diagnosis in combination with other tests. It is only after the application of all the tests described by the author that any attempt at diagnosis can be made.

A careful perusal of this part of the book makes one aware of the difficulties of diagnosis which must occur in many cases, and the imperative need for a special training in the subject. The majority of the medical profession are sadly unfamiliar with the diagnostic methods for high-grade amentia. The importance of a diagnosis is stressed by Prof. Berry, for investigations have shown that a large proportion of criminals and other anti-social individuals are made up of high-grade aments. In other high-grade aments there is the development of various neuroses and psychoses due to an incompetent brain being unable to cope with the stresses of modern life. The early diagnosis of high-grade amentia would enable the individual to be brought up in a suitable environment to the advantage both of himself and of the community. We can only wish that medical men, social workers, and educationists were familiar with the problem presented to society by the existence of high-grade amentia, and, above all, with the methods of attacking that problem. We cannot do better than to recommend them to read at least the last few chapters of this interesting book.

A more complete bibliography and more numerous references in the text would be an improvement. Some useful reference tables and a good index complete this attractively published volume.

J. C. ECCLES.

The Works of Roger Bacon.

(1) *Opera hactenus inedita Rogeri Baconi. Fasciculus VI. Compotus Fratris Rogeri, accedunt Compotus Roberti Grossecapitis Lincolniensis Episcopi, Massa Compoti Alexandri de Villa Dei*, nunc primum edidit Robert Steele. Pp. xxviii + 302. 1926. *Fasciculus VII. Questiones supra Undecimum Prime Philosophie Aristotelis*, nunc primum edidit Robert Steele collaborante Ferdinand M. Delorme, O.F.M. Pp. xii + 160. 1926. *Fasciculus VIII. Questiones supra libros quatuor Physicorum Aristotelis*, nunc primum edidit Ferdinand M. Delorme O.F.M. collaborante Robert Steele. Pp. xxii + 284. 1928. *Fasciculus IX. De Retardatione Accidentium Senectutis cum aliis opusculis de rebus medicinalibus*, nunc primum ediderunt A. G. Little, E. T. Withington. Pp. xliv + 224. 1928. (Oxford: Clarendon Press; London: Oxford University Press.)

(2) *The Opus Majus of Roger Bacon.* By Roger Bacon. A Translation by Robert Belle Burke. Vol. 1. Pp. xiii + 418 + 4 plates. Vol. 2. Pp. vi + 419-840 + 4 plates. (Philadelphia: University of Philadelphia Press; London: Oxford University Press, 1928.) 42*s*. net.

THERE has recently appeared a whole series of important works on Roger Bacon. Since 1926, four parts of the "Opera hactenus inedita Rogeri Baconi" have been issued from the Clarendon Press, and now an English translation of the "Opus Majus" appears, in two large tomes, from the University of Pennsylvania. The time is approaching when we shall be able to form a balanced judgment of Roger from a survey of all his works. In the meantime we must be content to consider these works separately.

(1) Mr. Robert Steele is responsible, in part or in whole, for three out of the four volumes which the authorities of the Clarendon Press euphemistically describe as 'Fasciculi.' The smallest of these diminutive works contains some 170 closely printed pages. The largest can only be completely studied by those who survive to the three hundred and thirtieth page. 'There were giants in those days.' Something more than ordinary enthusiasm is needed to sustain a man through years of such heroic labour as the preparation of these volumes implies. Mr. Steele has a standing in work of this kind that places him above criticism. We shall content ourselves by placing before the reader some abstract of the results of his labours and of those of his colleagues.

Fasciculus VI. deals with the "Compotus" of Roger. "Compotus" is the science by which time is reckoned. The need of such studies arose from the difficulty of combining a lunar calendar with a solar, since the lunar month and solar year are incommensurable. In the Middle Ages the matter assumed pressing importance, because of the stress laid on the fixation of the dates of the Church festivals, and notably of Easter. A number of works were produced on the subject, among which that of Roger takes an important place. Of it Mr. Steele rightly says that:

"The outstanding merit of this work, written at a time when Bacon was undoubtedly passing through a period of dejection, is that it forms a complete treatise on the calendar; it is a masterly exposition of what was known about the measurement of time at a period when astronomical observation with the naked eye had been pushed to its farthest point, and reduced to tables of great accuracy. It gives also an account of the history of the subject much fuller than is to be found in any of the earlier authors, embodying the knowledge of its time. Lastly, it is in itself a masterly and complete, though tacit, exposition of all the evidence against the assumptions of the ecclesiastical calendar; only towards the end of the treatise, when Bacon has summed up, does he allow himself to give free vent to a criticism where more cautious writers had been silent."

Fasciculus VII. is produced by Father Delorme in collaboration with Mr. Steele. It consists of Roger's lecture notes on the book which we now describe as the twelfth—not eleventh, as Roger calls it—of the "Metaphysica" of Aristotle. A study of it had been incorporated by the late Prof. Duhem in his magnificent treatise, "Le Système du monde." Book XII. of the "Metaphysica" is not of importance for the history of science, and the main interest of Roger's work on it is the evidence that it provides for the sources of his knowledge. It is well known that in his day the chief versions of Aristotle available had been rendered from the Arabic. The book shows, however, that Roger relied also on a very ancient version of Aristotle's "Metaphysica," rendered from the Greek. This is a point of more importance for the history of thought than might at first be supposed.

Fasciculus VIII. is also the joint product of MM. Delorme and Steele, and shows that for the "Physics," as for the "Metaphysics," Roger was using an ancient translation direct from the Greek. The treatise does not increase our estimate of Roger as an exponent of the experimental method, though it is of importance for the history of medieval philosophy. It must be remembered that the "Physics" of Aristotle scarcely deals with that subject as now understood, but with theoretical considerations that received no experimental proof.

Fasciculus IX. is the joint production of Mr. A. G. Little and Dr. Withington, and deals with the medical treatises. It is prefaced by a valuable introduction. There is no doubt of the importance of these treatises to the student of medieval thought, but we look for something higher from Roger. Here is his editor's estimate of these works:

"We must admit that the Epistle and treatises on old age are a grievous disappointment. . . . They show . . . close dependence on authorities he might have known were at best second hand, a simple faith in the marvellous power of remedies, most of which had been used for centuries with no remarkable results, and sometimes a pretence of secret knowledge which reminds us painfully of the alchemic quacks.

"Perhaps the best that can be said is that within twenty years of Roger's death, the greatest physician of the age, Arnald of Villanova, might have been seen diligently perusing one of these treatises, the *Liber de Conservatione Juventutis*, and working it up into another treatise . . . which he then dedicated as an original work to King Robert the Wise of Naples and Jerusalem."

Nevertheless, one of the treatises here printed ("De erroribus medicorum") contains perhaps the most forceful statement that Roger has made as to the nature of the experimental method. It may be translated thus:

"Since science is sure knowledge of truth, and since argument clinches truth but does not exclude doubt, no certitude is produced thereby till experience is added. And anyone finds this to be so in countless matters.

"Thus though the first proposition of Euclid is most powerfully demonstrated when it is said that all lines from the centre to a circumference are

equal, and that each side of a triangle constructed on a given line has that relation to it, and they are therefore equal to one another, the mind of the hearer does not come to rest in the truth till he have experience of the figure of two intersecting circles, with two lines drawn from the point of intersection to the ends of the given line, and not even then does he have absolute assurance unless he goes on to get definite experience by measurement.

"So, however much one should prove by argument to one without experience that a magnet attracts iron, and that such attraction would be possible in Nature, yet the man would never get assurance of it without experience. For we neither care so much for authority nor for reasoning *ad hoc* as for experience, and then the mind comes to rest."

(2) Undoubtedly the most important work of Roger is the "Opus Majus," on which, more than any other, his reputation is based. It is too much to hope—or at least it is too much to believe—that many will read the entire works of Bacon in their original Latin. But, despite modern detraction, Roger does take an important place in the history of philosophy, and it is therefore important that his leading work should be translated into English. Mr. Burke has, on the whole, done his work well. The scientific reader may rely upon the general sense of his version. There are indications that in places he is less acquainted with medieval usage than Mr. Steele and his collaborators in the "Opera hactenus inedita." That standard, however, is a very high one, and the 'book' is, in any event, an extremely useful addition to the library of the history of science.

Roger was a medieval, and his best points are buried in a mass of verbiage. Lest the reader miss his fine statement of the nature of the experimental method, with which he introduces Part VI., we here quote it:

"Having laid down fundamental principles of the wisdom of the Latins so far as they are found in language, mathematics, and optics, I now wish to unfold the principles of experimental science, since without experience nothing can be sufficiently known. For there are two modes of acquiring knowledge, namely, by reasoning and experience. Reasoning draws a conclusion and makes us grant the conclusion, but does not make the conclusion certain, nor does it remove doubt so that the mind may rest on the intuition of truth, unless the mind discovers it by the path of experience; since many have the arguments relating to what can be known, but because they lack experience they neglect the arguments, and neither avoid what is harmful nor follow what is good. For if a man who has never seen fire should prove by adequate reasoning that fire burns and injures things and destroys them, his mind would not be satisfied thereby; nor would he avoid fire until he placed his hand or some combustible substance in the fire, so that he might prove by experience that which reasoning taught. But when he has had actual experience of combustion his mind is made certain and rests in the full light of truth. Therefore reasoning does not suffice, but experience does."

CHARLES SINGER.

Preservation of Animal Remains.

Rezente Wirbeltierleichen und ihre paläobiologische Bedeutung. Von Prof. Dr. Johannes Weigelt. Pp. xvi + 227 + 38 Tafeln. (Leipzig: Max Weg, 1927.) 24 gold marks.

HUGH MILLER, viewing the hundreds of complete fossil fish which lay on a single bedding plane of the Old Red Sandstone, speculated on the causes which had led to so vast an accumulation, and on the repetition of this phenomenon at intervals throughout this series of rocks. The problem he then propounded is still unsolved, and to it have been added those which are presented by the bone beds in the Pontian of Pikermi and in many other horizons and localities.

It is most difficult for any geologist whose experience of the world does not extend beyond western Europe to conceive any conditions under which such masses of dead fish or dead mammals can have been brought together. Even the literature of geology gives little help. Thus Prof. Weigelt's excellent book should prove most stimulating to geologists, and especially to those vertebrate palæontologists who have to determine, as all must for their own satisfaction even if they do not publish their speculations, the conditions under which the animals with whose remains they are dealing lived.

Prof. Weigelt gives an account of all those changes which go on in the body of a vertebrate after death, and explains the events which may produce a carcase like those which are preserved as the Trachodon mummies. He then discusses those causes of death which are likely to affect large numbers of individuals at the same time, or to bring single creatures into positions where their remains have an exceptionally favourable chance of being preserved. He records death through volcanic activity, poisonous gases, prairie and forest fires, drowning, being mired in mud or quicksand, by floods, hunger and thirst, by hunters both human and other, by ice, snow, and mere cold. The last is illustrated by a remarkable case at "Smithers Lake" in south-west Texas. This shallow lake, 1500 acres in extent, is partly artificial, a dam

having caused it to spread over a forested area, killing all the trees; their stumps remain *in situ*, and their twigs and branches are carried about by currents. On Dec. 18, 1924, the air temperature in this locality had a maximum of 80° F. and a minimum of 68° F.; next day the maximum was 68° F. and the minimum 23° F.; whilst on the two succeeding days the temperature never exceeded the freezing point. This frost killed thousands of alligators, tortoises, and gar fish (*Lepidosteus*). In the February and March following the bodies of these animals had been collected into one area by currents and there lay in shallow water, which afterwards dried up. Prof. Weigelt publishes many excellent photographs of these victims which afford most accurate parallels to the appearances shown in fossil ganoid fish.

The numerous plates which illustrate the book will bring vividly before the reader conditions which are familiar to all who have travelled in arid regions but are scarcely appreciated by those who have not enjoyed such an experience.

The book should prove interesting to zoologists in general, as well as to those palæontologists to whom it is specially addressed.

D. M. S. WATSON.

Euclidean Geometry.

The Foundations of Euclidean Geometry. By Henry George Forder. Pp. xii + 349. (Cambridge: At the University Press, 1927.) 25*s*. net.

IT is interesting to compare the attitudes of the two most recent writers in English who deal with Euclidean geometry. Sir Thomas Heath, in the second edition of his three-volume translation of the "Elements" (Cambridge, 1926), reiterates his opinion that Euclid "remains the greatest elementary text-book in mathematics that the world is privileged to possess"; Mr. Forder, in the book under review, emphasises the fact that "many flaws have been noticed in his treatment during the two thousand years that have elapsed since his work was written." The two points of view are, of course, not in the least contradictory. Indeed, Sir Thomas Heath is careful to point out that "much valuable work has been done on the continent in the investigation of the first principles, including the formulation and classification of axioms or postulates which are necessary to make good the deficiencies of Euclid's own explicit postulates and axioms," and not the least valuable part of his great work consists in his notes and commentaries on research on the axiomatic side. Mr. Forder is mainly concerned with foundations, and his book will go far to remove the reproach implied in the words "on the continent" in the passage quoted. Having laid down his foundations, he goes on to erect his edifice of elementary geometry, remarking that "scarcely one proof in any school-text will survive a critical examination." Sir Thomas Heath would probably agree (cf. his original preface, loc. cit., vol. 1, pp. v-vi).

It is somewhat remarkable that no one before had written a "connected and rigorous" account of Euclidean geometry comparable with Veblen and Young on projective geometry; the gap needed filling up, and Mr. Forder has done it admirably. Naturally, the result makes somewhat heavy reading, and the temptation to ignore the advice "to make sure that the full formal proof can be given" in each case is very strong. Still, the numerous 'notes,' in smaller type and less formal phraseology, help to lighten the way along.

We begin with axioms of order, a three-termed relation between points, and work up to definitions of the line, the plane, and the space. (In parenthesis, may we ask whether it was really necessary to introduce the horrible verbs 'to colline' and 'to coplane,' and to abbreviate 'Theorems' into 'Thes.'?) The next chapter uses these axioms to develop theorems on angles and order relations between rays from the same point. Then come axioms of congruence. It is interesting to compare the author's blunt dismissal of the method of superposition, "this vicious method" (p. 91), with Sir Thomas Heath's more courteous historical treatment (loc. cit., vol. 1, pp. 225 ff.). We are next given applications to the properties of circles and spheres which do not depend on the parallel axiom; a new axiom concerning the intersection of two circles is necessary, and this in turn enables us to drop certain of the congruence axioms previously used.

Chap. vi. deals with parallel axioms, which distinguish Euclidean geometry from other geometries with congruence theories; various forms, differing in strength, are given and discussed, with applications to parallelograms and a digression on projective geometry. The author then proceeds, on the basis laid down, to develop a theory of proportion, to prove Pythagoras's theorem in a form in which there is no question of areas, to introduce co-ordinates and to consider constructions possible with ruler and compasses, with some reference to Mascheroni's constructions with compasses alone. Still continuing on the same basis, we study the dissection of polygons into triangles,

and so are led to the areas of polygons and the volumes of polyhedra.

In Chap. xiii. a return is made to axiomatics; an axiom of continuity is added, and it is shown how this enables us either to drop the congruence axioms or else to weaken the parallel axiom and drop some of the congruence axioms; both schemes suffice for Euclidean geometry and are consistent and complete. By way of appendix we are given an outline of a different method of procedure in which congruence is taken as the only undefined relation between points, and finally an excursus on non-Euclidean geometries.

We congratulate the author and the Cambridge University Press on an excellent piece of work.

Our Bookshelf.

(1) *Bolles Lee's Microtomist's Vade-Mecum: a Handbook of the Methods of Microscopic Anatomy.* Ninth edition, edited by Prof. J. Brontë Gatenby and Dr. E. V. Cowdry. With the collaboration of Dr. W. R. G. Atkins, the late Prof. Sir William Bayliss, J. Thornton Carter, Dr. Robert Chambers, Dr. W. Cramer, the late Dr. C. de Fano, Dr. Helen Pixell-Goodrich, Dr. J. G. Greenfield, Dr. Reginald Ludford, G. Payling Wright, and Dr. F. W. Rogers Brambell. Pp. x + 714. (London: J. and A. Churchill, 1928.) 30*s.* net.

(2) *Histological Technique: a Guide for Use in a Laboratory Course in Histology.* By Dr. B. F. Kingsbury and Dr. O. A. Johannsen. Pp. vii + 142. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 11*s.* net.

(1) THE new edition of this indispensable work has been enlarged, new sections have been added, some of the older matter has been omitted, and the names of new collaborators appear on the title-page. Full accounts are given of the technique of tissue cultivation and of micro-manipulation.

More care in editing would remove a few inconsistencies we have noticed. Thus a method for ripening hæmatoxylin solutions is described as having been "re-invented lately," the reference given being dated '1912.' Both the spellings 'methylen-' and 'methylene-' blue occur in text and index; in the latter they are separated, and the pages referred to are for the most part distinct. In fact, the all-important index would be the better for drastic revision, for as it stands it may be necessary to look up several headings to obtain the whole of the information on a particular subject. A good instance of this is 'Acid Fuchsin.' For full information on the uses of this dye several other headings must be consulted (*e.g.* Fuchsin, Acid; Säurefuchsin; Rubin S., etc.), as the page references given under each are for the most part different; *i.e.* they are not cross-references.

(2) The second book is essentially a guide to the fundamental methods of normal and pathological histology as required by the medical and the biological student. Fixation, sectioning, staining and mounting, the microscope, and special methods for blood, muscle, nerve, etc., are all dealt with, and a final section gives methods for the investigation of invertebrates in general. The information appears to be adequate and accurate, and the book should serve the purpose for which it has been written.

R. T. H.

The Potato: its History, Varieties, Culture and Diseases. By Thomas P. MacIntosh. Pp. xvi + 264 + 11 plates. (London and Edinburgh: Gurney and Jackson, 1927.) 12*s.* 6*d.* net.

POTATOES constitute one of the few foodstuffs in which Great Britain is still self-supporting, and great advances have been made in recent years on various problems relating to their culture. The growing menace of disease has directed attention to the classification and identification of the many varieties used in commerce, and, more recently, work in virus disease indicates a reason for the well-known degeneration of stocks. Questions of marketing and synonymous nomenclature are purposely omitted from this volume, but historical notes on the chief breeders and the varieties introduced by them are included.

Perhaps more than with any other crop, it is essential for all workers with potatoes, from whatever aspect, to have a thorough knowledge of the many varieties, and special attention is therefore devoted to their classification and to details of intervarietal differences. These are based on type varieties of the main groups, and the variations in different parts of the plant are clearly and comprehensively set forth and illustrated. The tubers are classified in tabular form, based primarily on colour.

Under modern methods of cultivation, potatoes are usually grown between two cereal crops to gain the full benefit of their cleaning value, and they are the best of all crops in their response to artificial fertilisers. As food they are chiefly valued for their high carbohydrate content, the proteins usually being ignored, but care is needed if they are fed uncooked to livestock. Industrially, they are widely used for alcohol production (giving a residual cattle food), potato starch and flour, dextrine, glucose, and for dried potatoes. The danger of attack by plant and animal pests is naturally great in such a universally grown crop, and virus, fungus, and bacterial diseases call for the utmost efforts of pathological research workers. Descriptive notes of some common commercial varieties, and a glossary of the more technical terms, conclude this most useful summing-up of modern work on potatoes.

The Fundamentals of Chemical Thermodynamics. By Dr. J. A. V. Butler. Part 1: *Elementary Theory and Applications.* Pp. xi + 207. (London: Macmillan and Co., Ltd., 1928.) 6*s.*

THE author believes that the student of chemistry should become acquainted with thermodynamical methods at an early stage, and his book affords an elementary introduction to the underlying

principles and their applications. It demands little mathematical equipment and is chiefly concerned with cyclic processes. All the nine chapters conclude with numerical examples to which, however, no answers are provided. Nearly half the book deals with the applications of thermodynamics to electrochemistry, and in some cases the material has little relation to thermodynamics. It is regrettable that the symbol δ has been used in place of the correct notation for partial differentiation. On p. 39 the transition point of rhombic to monoclinic sulphur is given as 95·5° C. in the text and 96·5° C. in the figure. In the consideration of gaseous reactions in Chapter v., the law of mass action is deduced by using two equilibrium boxes. This method of deduction does not correspond with any practical case and a better method is that used a few pages later for the maximum work, in which the problem is again worked out in detail and the external work term is introduced. The book is clearly and carefully written, well printed, and is reasonably priced. A second volume dealing with thermodynamical functions is promised.

Some Questions of Musical Theory. Chapter 3: The Second String; Chapter 4: Ptolemy's Tetrachords; With an Appendix: The Tiercetone Scale. By Dr. Wilfrid Perrett. Pp. iv + 31-98. (Cambridge: W. Heffer and Sons, Ltd., 1928.) 5*s.* net.

THIS is a continuation of the author's preceding chapters, "How Olympos found his New Scale" and "The Olympion," published in 1926. The first of the new chapters is a technical and historical discussion of the problem of the second string of the enharmonic tetrachord, and Dr. Perrett directs attention to the fundamental difference between the ancient and the modern practice of harmony, the Greeks apparently having no instruments constructed to give very deep notes, and the singers forming their chorus being men, whose vocal enharmonic would have to be written in our bass clef. The orchestration, mainly for harps and clarinets, must have been a light one, lying mainly above the voice part—more like what we should call an obligato.

The second chapter gives a careful analysis of the tetrachords of Ptolemy and their relation to the Tablature. Attention is naturally directed to the way in which we, accustomed to the Lydian mode, think of *the* scale as an uninterrupted series of eight notes, whereas the Greek musician looked upon the octave as composed of two descending series of four notes, two tetrachords separated by a "tone of disjunction." This view of the octave is still held in the Greek Church. H. D. A.

Myths and Legends of the Polynesians. By Johannes C. Andersen. Pp. 512 + 48 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1928.) 21*s.* net.

IN his preface Mr. Andersen admits that in the field of Polynesian mythology his personal gleaning has been small. He came too late in the field. He has accordingly availed himself freely of the work of Grey, of Percy Smith, and particularly of Elsdon Best, to name some only of those to whom he makes full acknowledgment. His own contribution to this survey is a running commentary and an abstract of legends not cited in full, which makes his book a survey of and guide to Polynesian tradition, culture, and belief. It is prefaced by a few general remarks on the physical character and languages and present conditions of the Polynesian which, brief as they are, give some background for the main theme of the book.

The traditions of Polynesian migration receive due attention, as do the creation legends and those in which Maui figures. The non-specialist public, for whom presumably the book was written, will find in its stories much that is beautiful as well as strange, while the folklorist whose interest is general rather than specifically centred on Polynesia will appreciate its value as a guide to original sources of information.

Progressive Trigonometry. Part 1: *Numerical Trigonometry and Mensuration.* By Frederick G. W. Brown. Pp. x + 222. (London: Macmillan and Co., Ltd., 1928.) 3*s.* 6*d.*

A PREVIOUS work of this author, "Higher Mathematics for Students of Engineering and Science," has already been favourably reviewed in these columns, and the present volume will supply a real want in the introduction of trigonometry at an early stage of the mathematical course. Mensuration is naturally dealt with more fully than when this subject is merely included in a text-book on arithmetic. The simple solution of a triangle is well treated. Throughout there are numerous examples of an interesting and practical character. In the last chapter mention is made of spherical triangles.

The book covers the syllabuses in mensuration and numerical trigonometry of most school examining bodies, and a second part is in preparation which will deal with the trigonometry required to the end of a school course. The whole should prove very useful.

Geology Manual: an Instruction and Laboratory Manual for Beginners. By Prof. Richard M. Field. Part 1: *Physical Geology.* Second edition. Pp. ix + 149. (Princeton: Princeton University Press; London: Oxford University Press, 1927.) 12*s.* 6*d.* net.

THE call for a second edition of this book within a year indicates that at least in the United States it has fulfilled a useful purpose. Practical courses in geology in the universities of Great Britain probably stand less in need of such external assistance, but most teachers will find that they can adopt some of the Princeton methods with advantage.

The new edition is enriched with sections on the chemistry of rock-minerals and the essential characters of the sedimentary rocks, and there is a brief introduction to the study of economic geology. The part of the book which deals with the interpretation of maps remains, as before, the best, though its appeal is necessarily to North America, except as regards the method of treatment.

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.*]

The Transmission of Ultra-violet Light through Tracing Cloth.

DURING an investigation of the effects of ultra-violet light on various types of blue print paper, it was found that ultra-violet light from a quartz mercury vapour lamp passed through ordinary commercial tracing cloth (or linen) to an extent both unexpected and surprising. A number of tracing cloths were obtained, and spectrograms were taken with three seconds exposure using a Hilger quartz spectrograph.

Specimens of various types of paper were also tested in a similar manner, and the results are shown in the photographs reproduced (Fig. 1), and in the accompanying tables.

TRACING CLOTHS.

No.	Type of Screen.	Approximate thickness in mm.	Mesh count per cm.	U.-V. Limit in Ångström units.
	None	..	..	2225
A	Excelsior	0·070	44 × 44	2535 (faint)
B	Imperial	0·070	47 × 47	2535
C	Excelsior	0·083	47 × 47	2535 (faint)
D	Imperial	0·081	43 × 43	2482
E	Lion	0·080	41 × 41	2482

PAPERS.

No.	Type of Screen.	Approximate thickness in mm.	U.-V. Limit in Ångström units.
	None	..	2225
P	Newspaper	0·070	3984
Q	Kraft paper	0·101	4339 (faint)
R	Wrapping paper	0·077	3125
S	Writing paper	0·069	3125

Thickness and the number of meshes to the centimetre do not seem to have much importance; the material itself seems to be translucent to ultra-violet

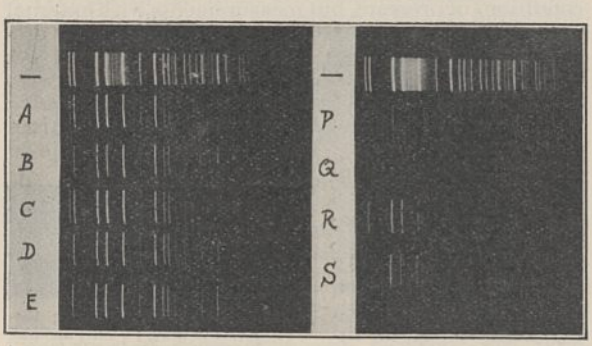

FIG. 1.

light. On the other hand, experiments made with thermopile and galvanometer showed that the heat from the sun or from a red-hot ball passed through the tracing cloth to a much less extent than through glass or vita glass.

Herein may lie the usefulness of this discovery, because, whether in sunlight or in artificial ultra-violet light, it is now possible to screen off much of the heat and yet retain most of the ultra-violet. A single layer of tracing cloth, between wide-meshed wire screens, can now replace curtains or blinds, and with this screen before an *open* sunny window it is possible to enjoy the advantages of ultra-violet light without undue heat or glare, although the eyes should be protected. Moreover, for country cottages, chicken farms, etc., it is now possible to obtain a cheap and effective substitute for the many glasses which have been manufactured to secure ultra-violet light in the more beneficial regions of the spectrum.

C. H. YOUNG.

McGill University,
Montreal, Nov. 22.

A New Band System of Carbon Monoxide.

IN an attempt to photograph the so-called spurious bands associated with the third positive carbon bands, on a 21-ft. concave grating, my plates showed a band at λ3893·2 which was completely resolved under the dispersion. I could also see some bands at λλ3681·1, 4125·0, and 4380·3. Good plates of these bands were obtained in the first order of the grating. The band at λ3681·1 is completely mixed up with one of the spurious bands beginning at about λ3694, and those at λλ4125·0 and 4380·3 are to a more or less extent similarly mixed up with the Ångström bands at λλ4123 and 4393 respectively. On the other hand, the band at λ3893·2 is completely isolated. The fine structure analysis of this band was therefore easily achieved. It has been possible also to analyse the fine structure of the bands at λλ4125·0 and 4380·3, since the structure of the superimposed Ångström bands is definitely known. No attempt has yet been made to analyse the band at λ3681·1 as the structure of the spurious band superposing it is not known.

It has been possible to arrange these bands as follows:

n' \ n''	0	1	2	3
0	27158·0 (H) (3681·1) 27165·5 (*o*) [1]	25678·7 (H) (3893·2) 25686·2 (*o*)	24235·6 (H) (4125·0) 24243·1 (*o*)	22823·4 (H) (4380·3) 22830·8 (*o*)

[1] Calculated.

The final state is thus identical with that of the Ångström bands. Fine structure analysis proves the correctness of this arrangement, the (0 – 1), (0 – 2), and (0 – 3) bands having identical $F''(j+1) - F''(j)$ values with those for the respectively similar Ångström bands.

Each band consists of one P, one R, and one Q branch, the latter being about twice as strong as either of the other two. One R line and one Q line are missing, and the transition is clearly $^1S \longrightarrow {}^1P$, the latter level being identical with that of the Ångström system. The initial level is about 5000 ν higher up than the initial level of the Ångström bands, and is thus identical with the new level at 91923 ν recorded by Birge (*Phys. Rev.*, **29**, 922; 1927). The new level is clearly shown by the present bands to be an ^1S level, and therefore the bands are very probably due to the transition $3^1S \longrightarrow 2^1P$, if the Ångström bands are $2^1S \longrightarrow 2^1P$.

The fact that the new system has only one n'' progression is noteworthy. The Ångström system has the $n' = 0$ progression well pronounced, but in addition possesses the first two members of the $n' = 1$ progression. The third positive carbon bands and the

3A bands are also remarkable this way. The critical potential of the new bands is 0·62 volt higher than that of the Ångström bands, and is thus about 0·2 volt higher than that of the 3A bands. Hence it is not surprising that they consist of only the $n' = 0$ progression.

The vibrational perturbation peculiar to the (0 – 0) and (1 – 0) Ångström bands seems to be also present in these bands. Though this is fairly certain, since the band at λ3681·1 is not analysed, this statement is only tentative.

It appears possible to identify with the above bands those recorded by Duffendack and Fox (*Astrophys. J.*, **65**, 220; 1927). The three bands recorded by them as associated with the Ångström bands are λλ3679·5, 3894·8, and 4380·1. I feel justified in saying that these are the three of the four bands discussed in this letter. If I am correct, the 'legitimate' objection raised by them to the present analysis of the Ångström bands obviously disappears. Deslandres' band at λ3893, which Wolter could not obtain (*Z. wiss. Phot.*, **9**, 361; 1911), is undoubtedly the band at λ3893·2.

I hope to publish a detailed account of this band system elsewhere. My sincere thanks are due to Dr. R. C. Johnson for helpful discussion.

RANGA K. ASUNDI.

Wheatstone Laboratory,
King's College, Nov. 19.

Striations in High Frequency Discharges.

IN the course of an investigation on the starting and maintenance potentials of the luminous column in argon, produced by applying a high frequency potential of wave-length from 10 to 300 metres to external sleeve electrodes, we found that steady striations were frequently developed. Using the method described by Townsend and Donaldson (*Phil. Mag.*, January 1928), an attempt was made to measure the potential fall over single striations to see whether any definite value could be assigned to it.

Steady striations have been observed at pressures ranging from the lowest pressure at which a discharge is obtainable to a pressure of about 10 mm. The most usual appearance of the striated discharge is that shown in Fig. 1. Fig. 2 shows the discharge in argon at the same pressure as in Fig. 1, but for a smaller distance between the electrodes. The luminous portions of the discharge sometimes have dark portions in the middle, giving them the dumb-bell appearance shown in Figs. 3 and 4. At pressures below 1/10 mm. the luminous portions become egg-shaped and have a clearly defined outline, as shown by the luminous portions at the ends of the discharge in Fig. 4. Fig. 5 is a photograph of the discharge under the same conditions as in Fig. 4, except that the distance between the electrodes is increased. The central part of the discharge has become a uniform glow, but a dark space can just be seen at each end of this glow, indicating that two more striations would have appeared had the electrodes been moved a little farther apart.

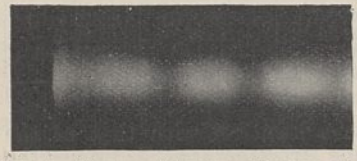

FIG. 1.—Pressure, 0·4 mm.; diameter of tube, 2·9 cm.; distance between electrodes, 11·5 cm.; λ = 80 metres.

FIG. 2.—Pressure, 0·4 mm.; diameter of tube, 2·9 cm.; distance between electrodes, 6 cm.; λ = 80 metres.

Striations have been obtained in discharges in argon in pyrex tubes 1·6 cm., 2·9 cm., and 3·9 cm. diameter for oscillations of wave-lengths 11, 40, 80, 160, and 320 metres. They are more easily produced when the longer wave-lengths and narrower discharge tubes are used. The distance between the electrodes when a given number of striations appear in the discharge is less in a narrow tube than in a wide one, as in the striated positive column of a continuous discharge. The lengths of the luminous portions increase as the pressure is lowered, and at low pressures each luminous portion gives rise to two egg-shaped striations. There are certain distances between the electrodes for which a whole number of striations is included, and the dark spaces are then very distinct. For intermediate distances which do not correspond to a whole number of striations, the dark spaces become almost indistinguishable and the luminous column almost uniform.

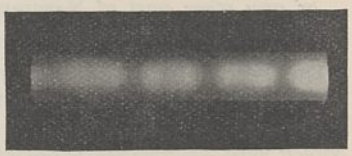

FIG. 3.—Pressure, 0·1 mm.; diameter of tube, 2·9 cm.; distance between electrodes, 17·4 cm.; λ = 80 metres.

When the potential difference between the sleeves is gradually decreased, and the minimum maintenance potential is approached, the glow usually becomes uniform. When the luminous column has the striated form, the potential required to maintain it is greater than when the glow is uniform. The striated form occurs more generally in argon than in helium and neon.

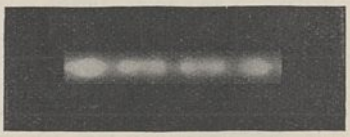

FIG. 4.—Pressure, 0·1 mm.; diameter of tube, 1·6 cm.; distance between electrodes, 10·5 cm.; λ = 80 metres.

Heidemann (*Ann. der Physik*, Band 85, Nr. 6, 1928) has recently described experiments on high-frequency discharges in hydrogen and in argon, and records a striated discharge in hydrogen, but not in argon. From measurements that he has taken for internal electrodes in hydrogen, he concludes that the fall of potential per striation is constant under different conditions of pressure, but measurements with external electrodes varied from 15·6 to 18·4 volts. Some preliminary measurements of the fall of potential per striation in argon, using external electrodes, were made, and the values of the potentials obtained varied from 9 volts to 20·5 volts, the pressures ranging from 1·26 mm. to 0·14 mm. The method adopted was to measure the maintenance potentials when a given number of striations was included between the electrodes. The distance between the electrodes was then increased so as to include one, two, or three more striations, and the maintenance potential again measured.

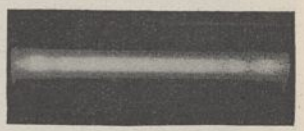

FIG. 5.—Pressure, 0·1 mm.; diameter of tube, 1·6 cm.; distance between electrodes, 17·5 cm.; λ = 80 metres.

The following table gives the results for a wave-length of 80 metres and a tube 2·9 cm. in diameter, where V is the potential required to maintain four

striations, and V_s the additional potential for each additional striation.

Pressure.	V_m.	V_s.
1·26	66·3	9
0·31	90·1	14·8
0·14	120	16·2

S. P. McCallum.
W. T. Perry.

Electrical Laboratory,
Oxford.

Critical Potentials of Light Elements for Simultaneous Transitions.

Investigations have been made by various workers to determine the energy levels of the outer shells of the atom by bombarding it with cathode particles of definite velocity and measuring the photoelectric current due to the radiation impinging on a metallic plate. Keeping the cathode current constant through the tube, the voltage is gradually increased, and it is found that at certain voltages kinks appear in the voltage–photoelectric curve. These kinks are attributed to the sudden appearance of 'new types of radiation' and the corresponding voltages are called 'critical potentials.'

Numerous observers (Richardson and Chahklin, Rollefson, Horton, Thomas, Compton, and others) have measured the critical potentials for the elements chromium to copper in the region from 40 to 200 volts, and in spite of certain disagreements between some of these values, due chiefly to the different values taken for W (the work necessary to remove the electron out of the metal) by different observers, it is found that there is a good agreement between them for about ten of these critical potentials, though these numbers are very much more than what is to be expected from the Bohr atomic model. For example, Andrews, Davies, and Horton (*Proc. Roy. Soc.*, vol. 117) have obtained critical voltages for copper in this region corresponding to 56, 67, 75, 85, 116, 131, 153, 196, 212 volts, whereas from the Bohr model one would expect critical voltages at 76·9 (M_2, $M_{II} - M_{III}$) and 119·7 (M_1, M_I) only.

Attempts have been made to explain the origin of the critical potentials by different observers, but none of them has been able to get the right result even qualitatively, though Richardson and Thomas have suggested the possibility of double ionisation in the atom.

In a previous communication to Nature (Nov. 17, p. 771) one of us (B. B. R.) tried to account for the existence of secondary absorption edges by supposing that the same quantum of radiation can successively knock out two electrons occupying the same or different energy levels in an atom. In a similar way we can explain the appearance of these critical potentials by assuming that in certain circumstances the same cathode particle can simultaneously eject two electrons either from the same or from different energy levels of the atom, and radiation is emitted due to simultaneous jumps of two electrons to fill up these two vacancies. The frequency of the radiation then emitted is equal to the sum of the frequencies due to the individual jumps. The idea of the emission of single quanta, as the result of the simultaneous transitions of more than one electron, has been already established in the field of optics (see Andrade, "The Structure of the Atom," pp. 563-564).

With this idea we have plotted Moseley curves with $\sqrt{\nu/R}$ as ordinate against Z in the region from iron to copper for such transitions as $2M_1$, $2M_2$, M_1+M_3, M_2+M_3, $M_1+(M_1-M_3)$, $M_2+(M_2-M_3)$, and so on. The values for M_1 and M_2 in this region are taken from X-ray, and N_1 from the optical data, whereas M_3 is obtained by extrapolation. On comparing the common values of different observers with those from the curve in these regions, we find that out of ten critical voltages, eight can be explained in this way; the error in any case is not more than 5 per cent. The values for chromium and manganese can also be deduced with success from these curves by interpolation. As for the other values, we are not sure if these are due to tungsten or to other impurities present in the metal. We also wish to point out that a large number of lines would accompany each of the transitions considered here in accordance with the Pauli-Hund rule as applied in the optical spectra.

This hypothesis of simultaneous transitions thus appears able to explain satisfactorily a large mass of hitherto unexplained experimental determinations of critical voltages.

B. B. Ray.
R. C. Majumder.

University College of Science,
Calcutta.

The Electromotive Behaviour of Single Metal Crystals.

Although the results of crystal analysis indicate that the electromotive characteristics of a metal, in common with other properties conditioned by inter-particle electrostatic forces, presumably vary with the orientation of the surface measured, no attempt seems to have been made to relate electrode potential measurements to a structure definitely describable in the crystallographic sense. The study of this structure-potential relation seems particularly desirable if electromotive data are to be correlated with photo-electric and electron condensation measurements. The measurement of a definite cleavage plane of a typical single metal crystal suggests itself as a suitable starting-point for such a study.

Measurements in oxygen-free solutions carried out at Yenching University, Peking, between June 1927 and June 1928 on three single zinc crystals, one of which was furnished by Prof. Bridgman, indicate that the primary cleavage face (basal pinacoid) of a zinc crystal is capable of yielding potentials constant to within 0·0001 volt and reproducible to well within one millivolt. The potential, further, was identical to that of the electrolytically deposited crystal conglomerate within the range of variation of duplicate conglomerate electrodes, a result which would be predicted if, as Bozorth (*Phys. Rev.*, **26**, 390; 1925) has shown, the electrolytic crystals are deposited with a random orientation and if the potential of the primary cleavage is a unique maximum. This second condition is rendered probable by the fact that the interplanar lattice distance is a maximum at the basal cleavage, but would depend upon any variation of the photo-electric work function with orientation. Attempts to prepare zinc crystals with naturally developed secondary faces sufficiently large for measurement have so far failed. Measurements on artificially prepared surfaces annealed and lightly etched have seemed to indicate a qualitatively regular decrease of potential with increase of inclination to the primary cleavage plane. This result is being checked by further work.

It may be pointed out that the use of the single crystal electrode offers a possible solution of the problem of obtaining satisfactorily reproducible electrodes of the high melting-point, rigid lattice metals.

Paul A. Anderson.

Yenching University,
Peking, China.

Investigations of the Scattering of Light.

PROF. C. G. DARWIN, in his interesting account in NATURE of Oct. 20, 1928 (p. 630), makes a reference to recent work on the scattering of light. It appears desirable in this connexion to point out that the existence in the light scattered by liquids and solids of radiations of modified wave-length was established so early as 1923 by investigations made at Calcutta. Dr. K. R. Ramanathan showed (*Proc. Ind. Assn. Sc.*, vol. 8, p. 190; 1923) that when violet rays pass through carefully purified water or alcohol there is an appreciable quantity of radiations in the green region of the spectrum present in the scattered light. Further studies of the effect in other substances are described by Mr. K. S. Krishnan in the *Phil. Mag.* for October 1925 and by me in *Jour. Opt. Soc. Am.* for October 1927. These investigations were of course well known to workers in this field.

In a lecture delivered at Bangalore on Mar. 16, 1928, and published and distributed on Mar. 31, investigations were described showing *first*, the universality of the effect, namely, that it is observed in the widest variety of physical conditions (gas, vapour, liquid, crystal, or amorphous solid) and in the largest possible variety of chemical individuals (more than eighty different substances); *secondly*, that the modified radiation is strongly polarised and is thus a true scattering effect; *thirdly*, that each incident radiation produces a different set of modified scattered radiations; *fourthly*, that the scattered radiations consist in many cases of fairly sharp lines in displaced positions; and *fifthly*, that the frequency differences between the incident and scattered radiations represent the absorption frequencies of the medium. These observations established and emphasised the fundamental character of the phenomenon in a manner which any isolated observation with a single substance would have quite failed to achieve.

The Russian physicists, to whose observation on the effect in quartz Prof. Darwin refers, made their first communication on the subject after the publication of the notes in NATURE of Mar. 31 and April 21. Their paper appeared in print after *sixteen* other printed papers on the effect, by various authors, had appeared in recognised scientific periodicals.

C. V. RAMAN.

210 Bowbazar Street,
Calcutta, Nov. 13.

A Fresh-water Medusa in England.

THE first record of a fresh-water jelly-fish in England was made by Sir Ray Lankester in a letter to NATURE, June 17, 1880. This little jelly-fish was found in the *Victoria regia* tank of the Botanical Society in Regent's Park, and is most widely known as *Limnocodium Sowerbyi*. By a deplorable decision of the Commission on Zoological Nomenclature, however, some modern writers have changed the generic name to *Craspedacusta*.

I have now to record the occurrence of another fresh-water medusa in a private aquarium in England. The discovery was made by Mr. Vernon Poulton, of Boscombe. With great skill and patience he succeeded in finding not only the free-swimming medusæ but also the very minute fixed hydrosome stage, and he has allowed me to see his preparations of both.

The medusæ undoubtedly belong to the genus *Microhydra*, which has hitherto been recorded only from North American waters, and I see no reason for suggesting that they differ from the type species *M. Ryderi*.

Among the water-weeds in the aquarium in which the medusæ were found were some plants of the American genus *Salvinia*, and it is possible that the *Microhydra* was imported into England attached to this weed; but according to Mr. Poulton's observations, the hydrosome stage was always attached to grains of sand and not to the *Salvinia*.

I wish to appeal to persons who cultivate *Salvinia* or other American water weeds in England to examine the water in their aquaria from time to time to see if these medusæ make an appearance. They are colourless and almost transparent, and the diameter of the bell is about 1 mm., or $\frac{1}{25}$ inch. The number of tentacles varies according to the age of the specimen, but there may be as many as twelve.

The medusæ of *Microhydra* may appear in large numbers and then disappear for a long period, just like the medusæ of *Limnocodium*, so that several observations should be made at different times of the year before abandoning the search.

In conclusion, I may say that, notwithstanding the opinion expressed by Mr. F. Payne in a recent paper, I am convinced that *Microhydra* is generically quite distinct from *Limnocodium*.

SYDNEY J. HICKSON.

Cambridge,
Dec. 10.

The Instability of a Single Vortex-Row.

SIR CHARLES SHERRINGTON, in NATURE of Sept. 1 last, directs attention to the eddy effect which in a heart valve "prevents extreme eversion of the valve, and facilitates closure of the valve without delay or hindrance so soon as the diastolic check of the stream current ensues."

It may interest readers of NATURE to know that this effect was described very clearly by Prof. George Britton Halford, the founder of the Medical School in Melbourne, the first in Australia. His views were published in the *Lancet* and in a local medical journal, but perhaps most fully in a book, "The Action and Sounds of the Heart" (Churchill, 1860), from which I quote the following: "A bullock's heart was obtained, and the auricles cut away nearly as low down as the auriculo-ventricular openings; the cavities of the ventricles were well washed out, and the coagula carefully removed. A vulcanised india-rubber tube of like diameter with the pulmonary artery was then attached by one extremity to the vessel, and by the other to a common forcing pump; water was then thrown into the pulmonary artery, and the semilunar valves tightly shut down, gentle pressure being maintained, in imitation of what takes place in life. The right ventricle, being empty, was in the same state as when the auricle is about to inject it. On pouring water into the ventricle the flaps of the auriculo-ventricular valve rose upon the surface of the fluid, until (the ventricle becoming fully distended) the valve formed a perfect septum between it and the auricle. The left side of the heart was tested in the same manner, and with results perfectly the same, notwithstanding the greater thickness of the valve, the larger size of the musculi papillares, and the stronger chordæ tendineæ."

I find that it is not absolutely necessary to have the emergent artery closed under pressure. The experiment in this simple form is made by my students individually—we call it Halford's Experiment—and always excites interest.

W. A. OSBORNE.

The University of Melbourne.

Nitrogen Fixation: the Growth of a New British Industry.[1]

HAVING now in general terms surveyed the *raison d'être* and the state of development of this modern industry, we will consider the circumstances of its establishment in Great Britain, and the remarkable vigour of its growth under the direction of the Imperial Chemical Industries, Ltd.

The War had been in progress for some time before the importance of the catalytic process for the production of ammonia, as a preliminary to its catalytic oxidation to nitric acid, was sufficiently realised outside scientific circles. In due course, however, the Nitrogen Products Committee was established and, whilst recommending the cyanamide process as being the only possible process concerning which sufficient information was then available, organised research in other appropriate directions. Much careful investigation was carried out and valuable results were accumulated, although at that time naturally not published. As a result of the work of Greenwood, Rideal, Partington, and others at University College, London, the Department of Explosives Supply decided in 1917 to erect a plant at Billingham, near Stockton-on-Tees, for the purpose of producing ammonium nitrate by Haber's process, a grant of five million pounds being made to finance the project. However, when about a quarter of this sum had been spent, it was found that the dimensions of the task were so great as to prevent its completion in time to be of military value. The whole scheme was re-examined in 1919, and considered to bear promise of fruition as a peace-time industry. Negotiations led finally to Messrs. Brunner, Mond, and Co., Ltd., agreeing to take over the assets and liabilities of the concern early in 1920, the technical staff, which had meanwhile been kept actively in being, moving to Billingham in June of that year; at the same time the subsidiary company, Synthetic Ammonia and Nitrates, Ltd., commenced its official existence. Now, of course, both of these companies form part of Imperial Chemical Industries, Ltd.

The whole problem had to be studied afresh from the beginning, and the first move was the establishment of a research laboratory, which, incidentally, cost some £80,000 (see Fig. 1). Simultaneously, a small plant was erected at the works of the Castner Kellner Co., Ltd., at Runcorn, where pure ammonia has been made continuously since June 1921 in increasing quantities. The hydrogen employed was a waste product in the electrolysis of brine for the manufacture of caustic soda and chlorine. The experience so gained was found to justify the erection of a complete plant at Billingham, using as much as possible of the old material, and designed for the production of 30 tons of ammonia per day; so rapidly and enormously has the factory grown (see Figs. 2 and 3) that the present capacity of 70,000 tons of fixed nitrogen per annum will, in 1929 or 1930, have been increased to 170,000 tons annually of fixed nitrogen, all of which, except for a comparatively small quantity employed in refrigeration, is used for the production of compounds of importance in agriculture, the dye industry, artificial silk industry, etc. In the meantime the village has become a small town, where 6000 employees will, in a couple of years, have been joined by a further 9000; where plans for 500

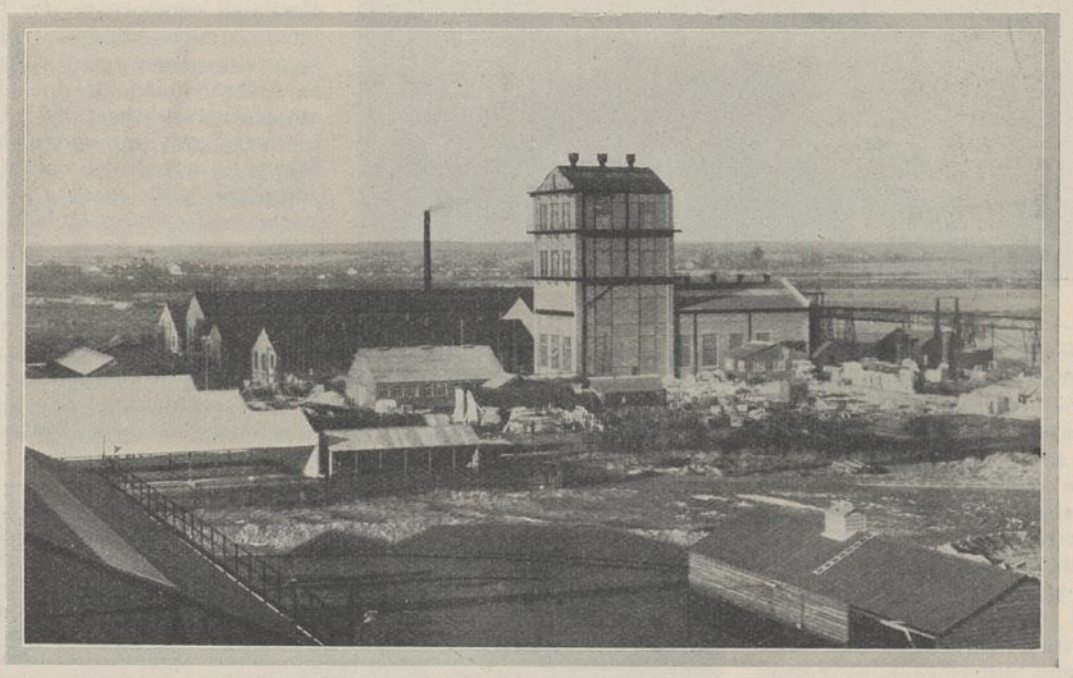

FIG. 1.—The laboratories of Synthetic Ammonia and Nitrates, Ltd., Billingham.

[1] Continued from p. 20.

houses, an entertainment hall, and a pavilion have been approved, and 500 more houses are in contemplation; where new playing fields and tennis courts are being provided; where, in short, a new industrial community is being established.

FIG. 2.—New hydrogen plant.

The technique of the production of ammonia by the Haber-Bosch process is essentially the technique of high-pressure reactions. It was immediately found that the ordinary types of plant, such as were then obtainable, were entirely inadequate for the needs of the new processes, so that the company was compelled to pioneer in this direction also, carving out its own path and learning during its progress. That the task of design and manufacture of such high-pressure apparatus is being satisfactorily accomplished is evident from Lieut.-Col. Pollitt's statement that the plant is in many respects simpler to operate and easier to maintain than low-pressure plant (see Fig. 4). The process, in outline, is as follows. Air and steam are together passed through incandescent coke in gas generators which provide for the efficient conservation of heat and full automatic control. From the product, which consists of hydrogen, nitrogen, carbon monoxide, and carbon dioxide, the carbon monoxide is removed by catalytic interaction with steam, and the carbon dioxide by treatment with water under pressure; the hydrogen and nitrogen in the proportion by volume of 3 : 1 are then highly compressed and subjected to the action of the catalyst in converters the working temperature of which is 500° C. The ammonia is dissolved in water and combined with some of the carbon dioxide previously removed. In order to avoid the use of sulphuric acid in converting this ammonia into sulphate, the more economical process of causing the ammonium carbonate to react, in aqueous solution, with anhydrite (calcium sulphate) is employed. Not only is the material ready at hand—there is a large deposit of anhydrite some 700 ft. below the site of the works—but also the calcium carbonate which is precipitated in the reaction is of industrial value, being produced in a form suitable for the manufacture of Portland cement, or for combination with ammonium nitrate to produce a new fertiliser known as 'nitro-chalk,' or for direct application to the land. Other products are ammonium bicarbonate, anhydrous ammonia, and nitric acid (see Fig. 5), the last-named substance being, of course, produced by catalytic oxidation of the ammonia.

Naturally, the experience gained in high-pressure technique is being simultaneously applied to reactions other than that from which it originated, such, for example, as the production of methyl alcohol from water gas by a catalytic process. It may eventually be possible to manufacture higher alcohols by means of this type of procedure, and the possibility of the conversion of methane, obtained by the distillation of coal, into acetylene and hence into numerous organic substances, is not to be ignored. These developments have necessitated laboratory and research staff extensions in

FIG. 3.—Ammonia plant.

rapid succession, for although the routine work has naturally increased, it remains a comparatively small fraction of the whole. The growth of an efficient instrument service, whereby so many different kinds of operation can be recorded and often controlled, whilst bringing in its train an important group of physical problems, simplifies in no small measure the task of accurate and knowledgeable control, and frequently indicates directions in which improvements are desirable.

It will be seen that the trend of industrial chemistry evidenced by the work at Billingham under the direction of Imperial Chemical Industries, Ltd., is no less than the replacement of products obtained from agricultural operations by products obtained from coal. Such a policy is in consonance with an era of mechanical transport, and it is peculiarly applicable to the British Empire. Although, as has been indicated, in any future war the fixed nitrogen industry might well find itself the base on which successful military action rested, and Billingham, Newcastle, and Birmingham might typify the pivot around which policy might revolve, it must emphatically be realised that the existence and development of this industry is a requirement,

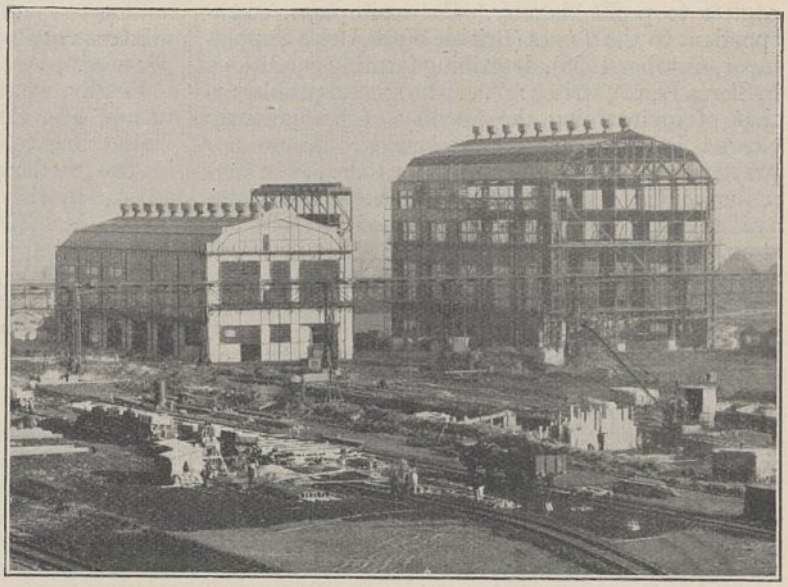

FIG. 4.—Buildings for new high pressure plant.

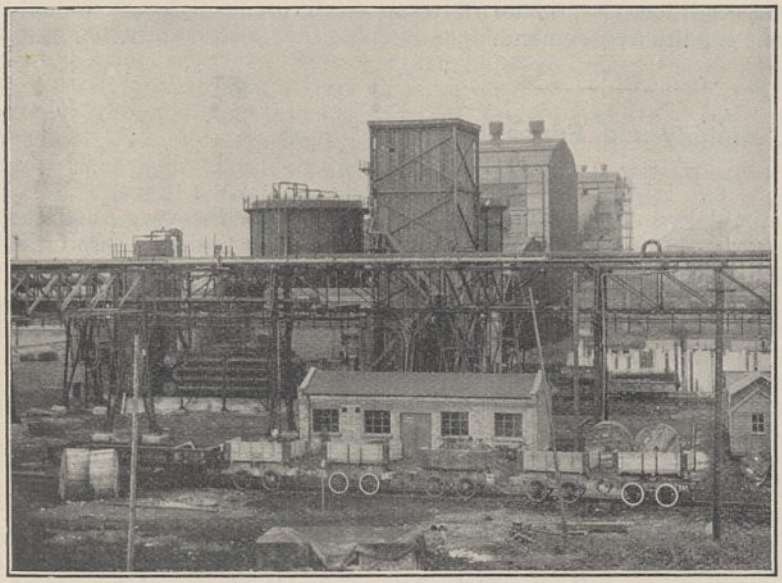

FIG. 5.—Nitric acid plant.

and an urgent one, of times of peace. It tends to bring comforts of modern civilisation within the reach of greater numbers, and its aim is to make two blades of grass grow where one grew before.

How far it succeeds in this latter aim can be judged, for example, from statistics supplied by Dr. H. J. Page, head of the Nitram Experiment Station, which is operated by Nitram, Ltd., an associated company dealing with the application of the products manufactured by Synthetic Ammonia and Nitrates, Ltd. Dr. Page shows that by giving grassland at eighty centres in the British Isles a basal dressing of phosphate and potash, and then successive dressings of ammonium sulphate at short intervals, the productivity is so increased that instead of two acres, only 0·72 of an acre is necessary to feed one cow. As Sir Daniel Hall has pointed out, British farmers can now modify the traditional practice of understocking. The British farmer, however, being somewhat conservative, and preferring usually to see before he believes, a 'Nitram' demonstration van tours the country in order to explain the new uses of sulphate of ammonia and nitro-chalk; the van carries instructional leaflets, specimens of the products of Synthetic Ammonia and Nitrates, Ltd., specimen turves, etc. A statement made at the second International Nitrogen Conference in the spring of last year by Sir Frederick Keeble is also worth recording, indicating as it does the margin between practice and possibility which is available for exploration and exploitation. He remarked that at a recent potato-growing competition organised by Nitram, Ltd., in Northern Ireland, the winner raised a crop of 28 tons to the acre, and no competitor raised less than 15 tons to the acre, whilst the average in England is less than seven tons per

acre. Parenthetically, it must be noted that although fixed nitrogen is of such great importance in fertiliser practice, soil requirements of other elements have also to be provided. Examples of the influence on crop yield of systematic fertilisation might be multiplied. So also might examples of neglect to profit thereby. For example, a correspondent to the *Times* (British West Africa Supplement, October 1928), describing farming conditions in Sierra Leone, writes : "... The second problem is that of maintaining the fertility of permanently cleared land by suitable manuring. There are practically no horses and very few cattle.... In consequence there is no form of farmyard manure available, and the average native farmer sets more store on putting up some sort of 'ju-ju' to protect and encourage his crops than on considering the purchase of artificial manures." Ju-jus, let it be observed, are of divers kinds.

The growth of the fixed nitrogen industry has lowered the prices, in terms of goods, of all nitrogenous fertilisers, and of phosphates and potash also, but we still lack sufficient accurate and co-ordinated scientific knowledge of the extent of the benefits which may be ours ; of the factors determining soil fertility and climate ; of the state of combination, interactions, proportions, and variations in the elements concerned. At Rothamsted it has been realised that although an enormous mass of data was being accumulated, it was not being employed to the best advantage by older methods of examination, and in consequence modern statistical methods have been applied. These methods have opened up a new line of study —the study of the influence of nutrients on the reaction of the plant to environmental conditions, that is, the influence of soil and climatic conditions on the effectiveness of fertilisers. Those in the best position to judge have declared that, if the general character of a season could be predicted, appropriate manurial schemes could be recommended, or tables of expectancy of crop yield could be constructed for the guidance of insurance companies willing to insure farmers using recognised fertiliser mixtures against getting less than an agreed yield per acre.

Finally, we must not, in contemplation of a rosy future, lose sight of the realities of the present. Unless new knowledge is acquired, unless education in the modern use of nitrogenous fertilisers is advanced, the danger of overproduction may be great. Mr. F. C. O. Speyer, the general manager and a director of Nitram, Ltd., estimated that if announced programmes in various countries are carried out, there should be an extra production of about 2¼ million tons of nitrogen between June 1928 and June 1931. He calculates that, although 92 per cent of this could be absorbed by Europe alone if applied to main crops at the rate of 0·8 cwt. per acre, the additional world population in this period would not consume more than half of the extra food which would thus be available. On the other hand, Dr. Bueb, managing director of the Stickstoff Syndikat, has pointed out that the monetary return on the use of nitrogen has steadily risen, and the prices of foodstuffs have been kept down. The problem of production is subject to the economic laws, but co-operation between the forces concerned—those directed by the chemist, the engineer, the agriculturalist, and the plant breeder, is so full of economic possibilities that it would indeed be unwise to base our estimate of to-morrow's need solely on to-day's demand. A. A. E.

Biology and Education.[1]

By Prof. F. A. E. CREW.

THE method of education is the stimulation of the cells of the brain by impressions from without : impressions provided by the casual and haphazard incidents of experience and by the deliberate and systematic agencies concerned with the imparting of facts and opinions. The aim of education is so to guide the development of the individual that he can hope to discover his powers, to recognise his limitations, and to determine the ways in which he may achieve the fullest degree of expression of his inherited mental and physical endowment in the circumstances, physical and social, in which he will find himself. Education, therefore, is concerned with the living individual and with the habitat in which this individual is to live and, living, achieve his destiny. So also is biology, the science which deals with the nature of living things and with the relation of these to their environment. It seeks to find answers to the questions as to whence came man, what is man, and whither goeth he. These are the very questions that occupy the popular mind to-day. Surely the tasks of the educationist must be those of equipping his experimental material with the ability to formulate these questions properly and of showing how and where their answers may be found.

The most conspicuous factor in the history of civilisation during the last two hundred years has been the exploitation of physical Nature by means of scientific knowledge. Science has provoked and made possible a complete metamorphosis of the western world since the middle of the eighteenth century, and during this time science has been nurtured by industry. The Europeanisation of the world had its origins in the developments of commerce, and the broadening of the mental outlook which distinguished the Renaissance was made possible by the increased wealth and the increased leisure this commercial prosperity gave to western peoples. The industrial revolution in England was but the inevitable sequel of the developments of trade during the period 1600–1750, and the present-

[1] From an address delivered before the Incorporated Association of Assistant Masters in Secondary Schools at Brighton on Jan. 1.

day appreciation of scientific knowledge in relation to the practical affairs of life is again the inevitable outcome of this industrial revolution.

It is because man has gained so spectacular a control over his physical environment that science exercises such a dominant influence in Western culture to-day; and it is because commerce has encouraged the development of the physical sciences for its own ends that physics and chemistry and allied sciences have grown so amazingly. But it is not because these sciences are so much more complete than are the biological that they find a place in the school curriculum. It has yet to be shown that physics and chemistry are keener tools wherewith to fashion mind than is biology. I submit that they are now taught simply because they have been taught, and because they are not only useful educational instruments but also profitable when the pupil is translated to secondary school, technical college, and university. Industry is demanding men trained in the physical sciences, and a knowledge of these subjects, while it may be helpful in a cultivation of the art of living, is most certainly useful in the business of earning a living. If men were bought and sold to-day, as they used to be, doubtless human biology would possess an equal importance.

No part of one's general education should be coloured, however, by any consideration of what one will do in order to live: general education is concerned solely with the development of an art of living, of teaching the developing individual how to think and how to feel and how to seek and gain opportunities for exercising these faculties. Manifestly, during this period the individual must receive an introduction to science, since it is of the utmost importance that youth should acquire the scientific point of view. Science has done more than merely give to man a marvellous power over material things: it has revolutionised human thought. It is this spiritual aspect of modern science that is its most significant virtue. The revolution is still spreading, and it is in a world dominated more and more by this scientific habit of mind that our pupils are to live.

Science has completely changed the concept of authority. Credulity is no longer accepted as a virtue and doubt as a sin. The final authority in spiritual as well as in temporal matters is no longer Scriptural phraseology and the traditional teachings of the sages of antiquity. The Old Testament is no longer accepted as a trustworthy text-book of human biology. Belief must now rest upon evidence that is open to examination, and critical judgment has usurped the place of authoritative statement. To-day, mankind demands the right to seek the truth and to extend it without restriction: facts, verifiable facts, are the only justification for authoritative statement. This concept has to be presented to and accepted by the youth of to-day.

It was this revolution in human thought that led to the replacement in education of the asceticism and scholasticism of the Middle Ages by the humanism of the Renaissance and later to the replacement of this in turn by science. To escape from the scholasticism that was becoming obnoxious it was necessary to turn to the literature of Rome and Greece. Latin, the language of the learned, became the vehicle of the new humanistic philosophy, and, because the new ideal found its counterpart in the thought of ancient Greece, Greek became the pathway to this older source of European culture. For these reasons, Latin and Greek assumed positions of great importance in education. Times have changed, yet even now the position of these classical languages in educational schemes is robustly defended, though the original need for their teaching has disappeared. The authority of tradition, enunciated in the pronouncements of classical scholars, no longer convinces. The average man can, and should be encouraged to, capture the spirit of this humanism in adequate translations and interpretations; if these do not exist, then the classical scholar is blameworthy: no one can afford to disregard the attitude of mind which requires that there shall be a spiritual joy in living and a confidence in the future, but the languages themselves are now the delicate hobbies of such as find more joy in the contemplation of the affairs of yesterday than in the adventures of living to-morrow. Every man does not require a knowledge of Greek, but he will require each day and every day a knowledge of the physico-chemical mechanism that is himself.

The acid test of scientific method is now applied in education, and the classics have been eroded. The day of passive acceptance of that which is, because it has been, is passed. It will be agreed that we are incredibly ignorant of what constitutes scientific procedure in education. It will be agreed, further, that because certain time-honoured standards have been overthrown the new ones are not necessarily final. The value of science in the school curriculum is that it can replace adequately the humanistic philosophy of life in combating and vanquishing fear of the unknown. This it is that physics and chemistry do, and that biology could do even better. The time has already arrived when physics and chemistry, sciences that deal with the phenomena of man's environment, should make room for biology, for it is biology more than anything else that is modifying human thought. To-day, the philosopher recognises the biological foundations of philosophy, the theologian the biological development of theology, the historian the biological framework of historical events. But more important than all this is the fact that the average citizen is intensely interested in the biological nature of his own existence. Biology occupies a pivotal position in human understanding, for mankind, having conquered its environment, is now seeking the control of itself and its destiny. The life of every man is affected in all its aspects by the two great generalisations of biological science — the theory of the cell and the theory of organic evolution. An introduction to these theories should therefore be given to all as part of their general education.

In the specialised scientific education that follows

upon the general, biology is a necessity; it is as indispensable for the embryonic chemist and physicist as are physics and chemistry for the biologist. Biology is no longer fragmented into the watertight compartments of zoology, botany, and physiology. Comparative morphology is no longer over-emphasised, and through the developments in genetics, ecology, and experimental morphology the barriers between zoologist, botanist, and physiologist have been broken down. The necessity for studying the physico-chemical processes of living organisms requires that the biologist shall be physicist and chemist as well, and the physicist and chemist with a knowledge of biology can find ideal material for the exercise of their techniques—the day of the biochemist and biophysicist has already dawned.

Biology in its origin was closely associated with medicine and with agriculture. The more scientific medicine and agriculture become the greater will be their demands upon biological science. As biology becomes more exact in its conclusions it will claim an even greater value in the social sciences, in which fields its main contribution as yet is the point of view which it imparts. But the significance of zoological and particularly of medical knowledge is becoming evident to the social worker, whose eagerness for the facts of heredity and hygiene is remarkable and will persist. When once there has developed a biology of the group, a scientific interpretation of human behaviour, then biology will indeed exert a most profound effect upon the social activities of humanity. The problems of evolution are no longer solved through the exercise of pure dialectic; biology has progressed towards the method of experimental analysis, and because its conclusions rest increasingly upon experimentation they are held in higher esteem. The voice of the biologist is now eagerly heard, because he speaks of facts that cannot be denied, of facts that concern the welfare of mankind.

Biology is not commonly included in a school curriculum, for the reason that the headmasters of yesterday had no knowledge of the biology of to-day. It cannot be expected that most teachers of physics and chemistry should themselves agitate for the appointment of a biological colleague, for the reason that it is quite obvious that the total amount of time allotted to science in the school curriculum cannot be advantageously increased, so that if biology enters the school it must necessarily reduce the time now given to physics and to chemistry. It is but to be expected, however, that I, a professional biologist in spite of my school education, should seek to advance the interests of my own subject. Science advances through the general acceptance of its teachings as much as by additions to knowledge. The teacher who pursues the implications of science and induces others to follow his example is no less important to scientific progress than he who contributes to the establishment of some technical generalisation.

In a university curriculum there is no time to present biological facts in a romantic fashion, and in any case the student's capacity for recognising the wonders of the living organism that is himself is spoiled somewhat by the economic necessity of equipping himself vocationally in the shortest possible time. He may become a biologist in later years, but at the university he is far too much occupied in his painful metamorphosis into a doctor, an agriculturalist, a veterinarian, an entomologist, or what not. Only those matters that seem to possess an importance to him in his professional capacity are of any real interest to him during this phase. Seldom does he capture the spirit of science; scarcely ever does he exhibit the scientific attitude of mind. Soon we shall see biology alongside chemistry and physics as a pre-registration subject: it would be that even now if the mechanism for teaching it existed in the schools. I, for one, look forward to the time when biology will be taught in the schools by carefully trained men, for school is the place where one should receive one's introduction to biology. That is the time and the place to give to the temperamentally suitable the spirit of the naturalist. This should be the endowment the school should give to youth.

At the present time the schools are providing the universities with a more than adequate supply of botanically attracted maidens, whereas what we need is an increased supply of young men who know that they are destined to be biologists. It is not because chemistry and physics are ultimately more profitable than biology that so many university students attend these courses; it is because so few have had biology at school, and because the majority of youths are urban-bred. At the present time there is a demand for men with a biological equipment that cannot be supplied. Imperial schemes for the advancement of agriculture are even now being embarrassed in their development because there are no young biologists to accept the posts that have been created. In the Dominions and Colonies, agriculture is the all-important industry, and in agriculture a knowledge of biology is of greater usefulness than is a knowledge of physics. Commonly, I am asked for advice concerning the prospects for a trained biologist. I answer that a well-trained man of suitable personality can readily start on a career which offers him a salary advancing from about £300 to £1000. To those who argue that this is not so good as a career in medicine, law, or commerce, I reply that I, for one, get from life rewards that cannot be found outside biology.

What is more important to humanity than the manufacture of helminthologists, entomologists, and the like is, however, the further extension and democratisation of the evolutionary concept. It was this that overthrew the medieval theology and completed the enlarging of the mental horizon of humanity. Man's notion of himself has changed from that of a being recently created and awaiting a day of reckoning in a not too distant future to that of a being originating as part of organic Nature and set in a universe without beginning and without end. This intellectual revolution has emancipated countless men from the bondage of authority. It

must free all. The evolutionary concept has been applied to religion and to philosophy. Its influence is seen in sociology in the incessant questioning of the necessity for existing conditions—it has shaken the whole edifice of social tradition. Disease and crime are no longer regarded as inevitable consequences of the organisation of society to be treated by curative measures. They are being attacked with all the scientific knowledge that we now have, and it is intended that they shall be eliminated by the evolution of a type of man and a form of society in which they will not exist. Man is no longer content to allow natural forces to work their will upon him; he has challenged Nature, bending it to his will, and hereafter will direct his own evolution.

The biological discovery of man's place in Nature has created the need for a biological training for priests and law-makers, for further developments of civilisation will be made possible only through the growth of biological knowledge. The nineteenth century saw revolutionary advance in the physico-chemical field; the twentieth will see equal advance in the domain of biology. In the past, man's control has been over inanimate things: now the conquest of living Nature has begun.

Antarctic Discoveries.

IN his nine hours' flight of 1200 miles over Graham Land on Dec. 19, Sir Hubert Wilkins made discoveries of great value. This was the first flight ever made in Antarctic regions and shows the value of air transport for the explorer in a part of the world where pioneer work has yet to be done. In a few hours, travelling at a speed of 120 miles an hour, Sir Hubert reached farther south than any ship has ever been able to penetrate on the eastern side of Graham Land, where Captain Larsen in 1893 had managed to reach lat. 68° S. Previous knowledge of the coasts of Graham Land ended, with any detail, on the eastern side in about lat. 66° S., and on the western side in about lat. 69° S. Beyond these latitudes, and even to the north of them in many places, knowledge was very sketchy.

The main features of Sir Hubert Wilkins' discoveries can be gathered from his dispatches to the *Times*. From Deception Island he and Lieut. Eielson flew south over the high peaks of Trinity Peninsula and the King Oscar coast, and almost exactly on the Antarctic Circle found an ice-filled twisting channel joining the Weddell and Bellingshausen Seas. The eastern end seems to open between the Weather (Wetter) Island of Larsen and another large island lying about 50 miles farther south. From the description, this island would appear to belong to the zone of basaltic rocks that lies to the east of the folded zone of Graham Land.

The eastern end of this strait was missed by Larsen and Nordenskjöld. Larsen was too far east owing to the wide ice-shelf on that coast preventing his ship approaching, and Nordenskjöld's farthest south on his sledge journey in 1902 was about lat. 66° S. Yet at that point he had a vague suspicion of the existence of a very long inlet if not a strait. At its western end the strait discovered by Sir Hubert Wilkins no doubt opens into the great Auvert Bay which Dr. Charcot placed north of his Loubet Land. Auvert Bay has not been explored and its eastern end is left blank on the charts. The *Times* reports that this new strait has been named Crane Channel.

Farther south Sir Hubert Wilkins reports that the rugged ranges of South Graham Land decrease in height but rise again towards lat. 70° S. In that latitude there exists a second strait, named Stefansson Strait, forty to fifty miles wide joining the Weddell and Bellingshausen Seas. Beyond this the ice cliff which borders the Weddell Sea from Coats Land westward seems to continue. Very possibly it continues through the strait, borders the Pacific Ocean, and reaches King Edward Land. About here Sir Hubert was forced by lack of fuel to turn, but he writes of the ice-covered surface sloping upwards to the south, which suggests the high plateau of Antarctica. This part of Antarctica receives the name of Hearst Land. The mainland of the southern continent is probably entirely of the same plateau structure with conspicuous fault ranges in the Ross Sea area. The theory that any part of the mainland is a region of Andean folding must now apparently be abandoned.

These details will of course be amplified in the course of time and the photographic record of the flight will help to make the picture complete. At present the news suggests that the folded ranges of Graham Land are lost by depression in about lat. 70° S. They probably skirt the ice-covered plateau of Antarctica, appearing as emerged land in such areas as Alexander Island, Charcot Land, the volcanic Peter Island, and perhaps King Edward Land. So little, however, is known of King Edward Land that its participation in the Andean folds cannot be stated with certainty. The existence of many large tabular bergs off Alexander Island, which appears to lie near the western end of the large strait, suggested to Dr. Charcot many years ago that shelf or barrier ice could not be far distant from that coast.

Sir Hubert Wilkins' discoveries thus throw light on one of the chief problems of Antarctica, namely, the relation of the folded Andean structure of Graham Land and the plateau structure of Victoria and adjacent lands and probably of Coats Land. The more striking discovery of the straits across Graham Land is actually of less importance. It has been known since the days of the *Belgica* expedition towards the end of last century that Graham Land was a heavily submerged area. Its continuity with the folds of South America has been lost by submergence. Belgian and French expeditions on the west, and Swedish and other expeditions on the east, have shown the extent of submergence in outlying archipelagoes and deep inlets. Channels crossing from coast to coast are not surprising in such a land. In South America such channels occur in the far south. These newly

discovered straits are probably seldom if ever clear of ice: in fact, they are probably filled with shelf or barrier ice rather than sea-ice.

Unfortunately, Sir Hubert Wilkins could not land, as his machine had wheels and he saw only snow surfaces fit for ski. But the discoveries show the way for future work, which it is to be hoped may be done at least in part by Sir Hubert himself during the present season. A flight from Deception Island to Com. Byrd's base at the Bay of Whales in the Ross Sea could not fail to have interesting results, but it would be a long flight and a far more hazardous than the one already accomplished. R. N. R. B.

Obituary.

DR. C. R. YOUNG, O.B.E.

CHARLES ROBERT YOUNG was born at Nottingham on Mar. 4, 1880, and was the son of Robert Young, a bank-actuary of that city. He received his early education at the Nottingham High School, and from there went to the Royal College of Science, where he remained from 1899 until 1901. He obtained the B.Sc. degree of the University of London and was then appointed lecture-assistant to Prof. Purdie of St. Andrews, a position which he held until 1903.

In 1903, Young was appointed research assistant to Prof. Purdie and lecturer in the University and, until 1907, was engaged in carrying out some important researches with Prof. Purdie. Among these may be noted a paper on the alkylation of rhamnose and one on the optically active forms of alkyl oxysuccinic acid, two important applications of the reaction for the alkylation of hydroxy compounds introduced by Purdie which has proved so fruitful in elucidating the constitution of the sugars. He was awarded the D.Sc. degree of the University of St. Andrews on the results of his research work. From 1907 until 1915 he held the post of lecturer in chemistry at the University of Sheffield, and here, although his duties prevented him from continuing his research work, he proved himself to be an able and effective teacher.

When the late Dr. A. W. Crossley, early in 1916, resigned the secretaryship of the Chemical Warfare Committee in order to take over the control of the then newly established experimental station at Porton, he was moved to recommend Young for the post, for Crossley was a great judge of men, and had recognised Young's special qualifications while acting as external examiner at St. Andrews and Sheffield. From this date until the end of the War, Young fully justified Crossley's choice and carried out the duties of his difficult office with that tact, discretion, and thoroughness which characterised all his work. He endeared himself to all members of the Committee by his willingness to serve and by his innate modesty and unfailing courtesy. When in 1919 there arose the question of the appointment of a technical officer for the Department of Scientific and Industrial Research, the three members of the Committee, who were also members of the Advisory Council of the Department, were unanimous in recommending Young for the new post.

Young served the Department for nearly ten years, and was, at the time of his death, secretary of the Scientific Grants Committee. All those who came in contact with him, both in his official and personal capacities, recognised his true worth. He had a kindly, rather shy, temperament and a very lovable disposition. Self-effacing and modest, he nevertheless held his views strongly and was quick to express them with force when occasion required. He was created an Officer of the British Empire for his War services. He died on Dec. 26 last, after a brief illness, and leaves a widow and two daughters. J. F. T.

WE regret to record the death of Dr. Dawson F. D. Turner at the age of seventy-one years. He was one of the few medical men who took up the study of X-rays in medical work in the real pioneer days. Unfortunately, he suffered from the rays when their dangerous character was scarcely known, but this did not prevent many years of excellent work on his part. He was head of the X-ray department in the Edinburgh Royal Infirmary for nearly twenty-five years, and during this time contributed original papers on the subject of X-rays and medical electricity. His book on the therapeutics of radium was one of the first, if not the first, published in Great Britain. He was a vice-president of the Röntgen Society, and at one time president of the Royal Scottish Society of Arts.

WE regret to announce the following deaths:

Prof. John M. Coulter, professor of botany in the University of Chicago from 1896 until 1925 and a foreign member of the Linnean Society of London, who has been editor of the *Botanical Gazette* since 1875, on Dec. 23, aged seventy-seven years.

Mr. J. S. Diller, who served with the U.S. Geological Survey for forty-one years and was well known for his studies of the geology of the Pacific Coast, on Nov. 13, aged seventy years.

Dr. Alois Kreidl, professor of physiology in the University of Vienna, on Dec. 6, aged sixty-four years.

Prof. F. P. Leavenworth, emeritus professor of astronomy in the University of Minnesota, known for his work in astronomical photography, on Nov. 12, aged seventy years.

Sir Charles Macara, Bart., founder of the International Federation of Master Cotton Spinners' and Manufacturers' Associations and widely known in industrial circles, on Jan. 2, aged eighty-three years.

Prof. E. H. L. Schwarz, professor of geology in Rhodes University College, Grahamstown, South Africa, on Dec. 19, aged forty-five years.

Sir Henry Trueman Wood, secretary from 1879 until 1917 of the Royal Society of Arts, on Jan. 7, aged eighty-three years.

Prof. Alexander Ziwet, professor of mathematics at the University of Michigan since 1888, and an associate editor of the *Bulletin of the Mathematical Society*, on Nov. 18, aged seventy-five years.

News and Views.

THE descriptive statements which have been published from time to time indicate both the nature of the King's illness and the treatment adopted more fully than is possible in the daily bulletins and enable a clear picture of the course of the malady to be formed. The illness began as a streptococcal septicæmia, with later localisation of the infection between the base of the right lung and the diaphragm: such a 'fixation abscess' is of favourable import, since its appearance is usually followed by a lessening of the general infection. Apart from treatment directed towards the maintenance of the patient's strength, including the assimilation of appropriate nourishment, the aim has been to aid the development of the body's defences against the attack of the micro-organisms and to maintain the blood and tissues generally in as nearly normal a condition as possible. Thus the application of ultra-violet rays to the skin in suitable dosage should result in an increase in the bactericidal power of the blood; whilst the organisms in the abscess cavity in the chest can be more directly attacked by the application of antiseptic solutions. For this latter purpose a solution of hypochlorous acid containing active chlorine, which was developed during the War by Carrel and Dakin for the treatment of septic wounds, has been used: its advantages are that it is almost non-toxic to living tissues, including the white cells of the blood which enter the abscess cavity to ingest and destroy the organisms, although acting deleteriously upon the organisms themselves.

IN the early days of the King's illness the presence of the organisms in the blood stream resulted in a definite anæmia, but with the lessening of the infection the number of red blood corpuscles has increased again and a transfusion of blood has not been considered either necessary or advisable. On the other hand, chemical examination of the blood has of late shown a deficiency of calcium, which is being combated by the administration of a salt of this element with parathyroid extract. The parathyroid glands are known to have some control over the calcium metabolism of the body; experimental removal is followed by a fall in the blood calcium, accompanied by the development of muscular spasms known as tetany: administration of an extract of the glands raises the blood calcium and abolishes the symptoms. The extract is effective also in other conditions not obviously connected with disturbance of the parathyroid glands, in which the blood calcium has fallen to a subnormal level. In the present case it is probable that the presence of the abscess in the chest has effected a drain of this element from the blood. Elevation of the blood calcium will also aid in raising the blood pressure, which has fallen below the normal level during the course of the illness. Improvement appears to be taking place slowly, but surely enough to justify the hope that the King will be restored to his people.

THE sixth annual meeting of British Zoologists was held in the rooms of the Zoological Society on Jan. 5, ninety zoologists being present. The meeting discussed the interim report of the Royal Commission on National Museums and Art Galleries, and after a long and interesting discussion passed, unanimously, a resolution "That the Trustees of the British Museum be approached in order to represent the urgency of putting upon an equal and independent basis the direction of the two branches of the British Museum at South Kensington and Bloomsbury." The important research work, not only in academic but also in economic zoology, which is carried out in the Natural History Museum is held by zoologists to justify an autonomy which does not at present exist. The needs of the Museum and the nature of the work carried on in it differ so greatly from those of the library and archæological sections, that the necessity of conducting business through the accounting office at Bloomsbury necessarily involves a hindrance to its work.

THE meeting of British Zoologists also discussed the present shortage of trained zoologists for technical posts. Instances in which it had been impossible to find a suitable applicant for most attractive posts were reported. Mr. S. G. Tallents, the secretary of the Empire Marketing Board, showed that a considerably increased demand for biologists may be expected from the tropical dependencies. The shortage seems to depend on the unwillingness of students, or of their parents, to face the risks of undertaking a career in which the total number of posts is very small in comparison with the openings in such a profession as medicine or even with those available to chemists. The attractiveness of zoology as a career is further decreased by the fact that even the most highly paid zoologists receive a salary which would represent no more than a very modest success in medicine or other professions. In addition, zoological appointments fall to be made at irregular intervals, and are unpredictable. It is thus impossible to ensure a student whose interest is in fisheries research that there will be a post vacant four or five years hence when he finishes his university course. Zoologists of the last generation pursued that science because they felt that it mattered, to them at any rate, more than other things; they trusted to their abilities to gain them a livelihood, even if a poor one. The modern student wishes certainty, a permanent post with a pension. The meeting passed a resolution in favour of the establishment of an association of professional zoologists and appointed a committee to consider the constitution of such a body.

WE fear that the advocates of better and more extended biological teaching in schools will read the recent correspondence on this subject in the *Times* with mixed feelings. The correspondence began with Sir Charles Robertson's comments on Mr. Ormsby-Gore's report of his visit to Malaya, Ceylon, and Java, which is the subject of the leading article in this week's issue. Sir Charles indicates four main causes for the present unsatisfactory position: our urbanised

and industrial outlook; the dominance of chemistry and physics in the school science course; the congested school curriculum; the newness of the subject. He believes that until the situation in the secondary schools is altered, no amount of propaganda by government bodies and no changes in the attitude of the universities will avail in providing the greatly increased number of qualified biologists urgently needed in the Empire. In this he will be fully supported by those who have studied the problem of introducing a proper biological course into the schools. Nevertheless, it is only an incidental reason, great though its material importance undoubtedly is. The real justification is set out, almost alone among those taking part in the correspondence, by the headmaster of Dauntsey School: 'Biology has a spirit and soul as well as a money value.' For the rest, the arguments cover familiar ground. The universities are blamed by some for unwitting obstruction, and are praised by others for encouragement in excess of that warranted by present conditions. Attention is directed to the disparity of income between leading biologists holding official positions, and moderately successful lawyers, doctors, and tradesmen—a contrast which loses much of its point because it applies to physicists and chemists as well, with the exception of a very few in the leading industrial organisations.

WE can only hope that constant ventilation of the subject will help to direct attention to the analysis of the position and the definite recommendations made in two reports, dealing with animal biology in the school curriculum, and science in the school certificate examinations, respectively, which were presented at the Glasgow meeting of the British Association. If any doubt existed as to the urgent need of fully trained biologists in the Empire, it would be removed by Mr. Ormsby-Gore's address on "Developments and Opportunities in the Colonial Empire," given at University College, London, under the auspices of the Association of Scientific Workers. He pointed out that nearly all the non-self-governing colonies have now reached the stage of evolution necessitating the establishment of a whole series of technical services to assist their economic and cultural development. The majority of the non-self-governing colonies lie in or near the tropics, and their resources are almost entirely agricultural. Biologists, specialised in the numerous branches of this science, are urgently needed in the agricultural field and in all branches of medical work. In addition to this perhaps self-evident need, there is the highly significant fact that in the very difficult task of educating the native population the only contacts between the mind of the British teacher and that of the indigenous population are biological. The natives cannot see any benefit in education unless it deals with their ever-present preoccupations—their struggle for existence, the health of themselves, their animals, and crops.

THE Council of the Physical Society has awarded the sixth (1928) Duddell Memorial Medal to Dr. Charles Édouard Guillaume, the Director of the Bureau International des Poids et Mesures, Sèvres. The medal is awarded annually to some one who has contributed to the advancement of knowledge by the invention or design of scientific instruments or by the discovery of material used in their construction. Dr. Guillaume is known to the world for the invention of three metallic alloys of great importance, invar, elinvar, and platinite. Industrially, the last one of the three is much the most important. It is a nickel-iron alloy having approximately the same temperature coefficient of expansion as glass, so that it can be fused into glass and used as the wire for introducing the current into electric incandescent lamps. The wire is frequently covered with a thin coating of copper to which the glass adheres, and in this form the wire is known as 'red platinum.' As about one thousand million lamps are made annually, the saving between the cost of platinum wire, which was the only suitable material formerly available, and the alloy, approximates to £1,000,000 per annum.

THE other two alloys associated with Dr. Guillaume's name are of great scientific importance. Invar, a nickel-steel, discovered in 1896, has practically no temperature coefficient of expansion, so that the length of a surveying tape made of it is almost unaffected by temperature. Its use in accurate surveying work has reduced the time taken to one fiftieth of that required a few years ago. The pendulum rods of all modern first-class clocks are also made of the same material. The third material, elinvar, was invented by Dr. Guillaume for the manufacture of the balance springs of watches. The coefficient of elasticity of elinvar does not change with temperature, so that the control exerted by the spring does not vary with temperature. It is estimated that about five million watches are made annually in which the balance springs are of this material. In his earlier scientific career, Dr. Guillaume did a great deal to develop the accuracy of measurement obtainable with the mercury-in-glass thermometer. His book "Traité pratique de thermométrie de précision," published in 1889, has remained the classic on the subject. Dr. Guillaume has published many papers connected with the standards of metrology, and his name is synonymous with accuracy of measurement. He was appointed Director of the Bureau des Poids et Mesures in 1915, and received the Nobel Prize for physics in 1920.

THERE was an international celebration of Sir J. C. Bose's seventieth birthday on Dec. 1. In India the Maharaja of Nepal, the governors and chancellors of different universities, sent their delegates, and Rabindra Nath Tagore composed a special poem for the occasion. Congratulatory messages were received from many leading representatives of progressive knowledge in Europe; and Romain Rolland, the distinguished man of letters of the Sorbonne, Paris, wrote: "You have incorporated into the Empire of Spirit the new Universe of Life which only yesterday was taken as unconscious, dead and buried in the night." The National Research Institute, Nanking, sent the message that "the world looks to you to lift science into the realm of Spiritual Reality. All Asia

shares in your glory." Sir J. C. Bose in course of his reply, said that he had "for the last forty years worked towards winning for India a recognised place among federation of nations by her contributions for extending boundaries of knowledge. The world is to-day divided into warring hosts threatening the very existence of civilisation. There is only one way to save world-wide ruin, and that is by intellectual co-operation for the common benefit of mankind." At a meeting of the Senate of the University of Calcutta on Dec. 8, a resolution was passed congratulating Sir J. C. Bose on the work he has done for the advancement of science.

IN a paper entitled "Economic Application of Electricity to Low Temperature and Heating Purposes," read before the Institution of Heating and Ventilating Engineers on Jan. 2, Mr. G. Wilkinson described an economic application of electricity for heating purposes by means of a 'change-circuit.' By this means the load factor of supply stations can be increased and domestic electric heating becomes a possibility on cost alone. Mr. Wilkinson said that, assuming an increase in load factor from 25 per cent to 75 per cent, there were available during the year 1927–28 for heating purposes the enormous total of 19,855,701,260 kilowatt-hours at $\frac{1}{3}$ penny. This amount is being increased every day with the growth of the constant voltage supplies. Energy in the form of electricity has the advantage that it can be readily delivered at any point where heat is required, and the expense of pipe transmission and heavy heat losses of transmission are saved. Each floor of a building, and if necessary each radiator or panel, may have its separate storage cylinder which will absorb the constantly varying amount of energy received from the 'change-circuits,' thus forming a heat reserve to be drawn upon at such times and rates as required to maintain uniform temperature under all weather variations. The absence of combustion and the products of combustion enables these cylinders to be placed in positions where any radiation loss is usefully employed, and the whole system lends itself readily to convenient applications not obtainable with any other form of heating.

NOISE, it is becoming realised, is an important and to some extent preventible affliction which civilised and gregarious human beings are called upon to suffer. Although, in a strictly scientific sense, all noise is not harmful, or even unwelcome, the pleasant noises are generally called by some other name. Among the definitely deleterious varieties is undoubtedly that of modern road traffic, and any means of dealing with that part of the nuisance amenable to treatment—provided such means are reasonably economical, fairly efficient, and not unduly inconvenient—are bound to attract the serious consideration of highway engineers, of medical men, and of dwellers in noisy cities. In a paper read by Lieut.-Col. T. H. Chapman at the conference on rubber roadways and floor coverings, held under the auspices of the Institution of the Rubber Industry and the Rubber Growers' Association on Jan. 3, a useful survey of progress in the employment of rubber for this purpose was presented. It is not claimed that rubber is, in every sense, an ideal material, for such would exhibit absolutely no deterioration or wear under usage and weather. Rubber is, however, smooth without being slippery, hard yet resilient, impervious to moisture, dustless, and easily cleaned; it absorbs vibration, diminishes noise, and requires no maintenance; hence rubber goes a long way towards meeting the requirements of the ideal. Whilst granite setts, asphalt, and wood blocks all have their distinctive advantages, there are special areas where the cost of rubber should not be allowed to obscure its obvious merits. The latest examples of rubber paving laid in London are on the approach to Fresh Wharf (London Bridge), in New Bridge Street (Blackfriars), Thurloe Place (South Kensington), and Croydon Road (Anerley); at Edinburgh in Shandwick Place, and at Glasgow in Buchanan Street. Lieut.-Col. Chapman indicated directions in which technical difficulties are still obstructive; at present, for example, rubber cannot be laid and then vulcanised *in situ*, although an advance in the direction of 'carpeting' with vulcanised rubber appears practicable. So far as reduction of noise is concerned, tests in Whitehall showed that, compared with wood paving, the reduction was 30 per cent, that the residual noise was less objectionable, and that vibration was diminished.

RUBBER flooring was discussed at the same conference by Dr. S. S. Pickles. Here the problem is less of a technical than of an educational nature. The reputation of rubber as a floor covering is well established, and despite the somewhat high initial cost, the low price of rubber now affords wider opportunities for its employment. Its shock-absorbing properties and comparative noiselessness are self-evident advantages. It is, moreover, interesting to note that its use in a London church was attended by an improvement in the acoustic properties; rubber flooring thus absorbs sounds already produced. Further, the poor conductivity for heat and electricity, the resistance to abrasion, and the fact that it is waterproof and non-absorbent, all contribute significantly to its claims for a more widespread public and domestic use. Dr. Pickles gave much information concerning the types and properties of rubber floor coverings which should prove of service to an architect desiring to develop flooring schemes in keeping with the character of his structure. Incidentally, he mentioned that he had had under personal observation for nearly twenty years rubber floors in a chemical laboratory and in a power house; both were still in excellent condition as regards wear. When referring to the types of apparatus employed in estimating the suitability of rubber and rubber compositions, and to the need for constant examination and control of products on the part of manufacturers, he said that if a composite plate of rubber and steel is subjected to a sand blast, the steel portion may be worn completely through, leaving the rubber almost unaffected.

THE Institution of Chemical Engineers has decided to institute, in commemoration of the late Lord

Moulton, two awards for papers on chemical engineering subjects. The senior award will consist of a medal in gold, bearing a likeness of Lord Moulton on the obverse, and be awarded for the best paper of the year of a mature character, read before the Institution and published in the *Transactions*. The award will not be confined to members of the Institution. The junior award will consist of a similar medal in silver, with a prize of books to the value of £3, for which graduates and students of the Institution only will be eligible. The award will be made for the best paper of the year communicated to the Institution, and deemed of sufficient merit to be published in the *Transactions*.

IN connexion the World Engineering Congress which will be held at Tokyo on Oct. 29–Nov. 22 by the Kogakkai, or Engineering Society of Japan, and supported by the Japanese Government, a conference of representatives of twenty-three institutions and societies met recently at the Institution of Civil Engineers to consider the best means by which British representation at the congress could be organised. As a result, "The British Committee on the World Engineering Congress in Japan" was formed, having its secretariat and place of meeting provided by the Institution of Civil Engineers. The Committee has as its objects the organisation of a party of British engineers to attend the Congress, and the securing of papers for presentation, and a small executive committee under the chairmanship of Sir Brodie Henderson has been appointed. The Congress will be the first of its kind held in Japan, and it is evident that the Japanese with their usual energy are making every effort to make it worthy of the progress achieved in that country. It is therefore the earnest wish of the Committee to awaken the interest and enlist the support of engineers, so as to ensure adequate British representation at the Congress by the presence of a large party of delegates and by the presentation of a number of papers.

RADIO advices from the non-magnetic yacht *Carnegie*, which left Balboa, Canal Zone, on Oct. 25 for the first passage in the Pacific of her Cruise VII, state she arrived at Easter Island on Dec. 6, four days ahead of her schedule, with all well on board and after a fine trip with ideal weather conditions and no storms. The observational work during the passage from Balboa to Easter Island included 58 magnetic stations, 10 ocean and tow-net stations, 70 sonic depth-determinations, 24 pilot-balloon flights, 6 evaporation series, 23 biological stations, 25 days of photographic records of atmospheric electric potential gradient, and four 24-hour runs of other atmospheric electric elements. Because of a slight leak which developed in the depth-finder oscillator (mounted on the keel of the vessel), echoes for soundings have been obtained through firing of a shotgun at the end of a pipe extending 20 feet below the surface; the results with this emergency arrangement have checked well with depths determined by wire and pressure.

IN commemoration of the centenary of the birth of John Innes, the council of the John Innes Horticultural Institution, Merton, is holding a conference on polyploidy as a source of species and horticultural varieties, on Saturday, Jan. 19, at 2.30 P.M. All who are interested are invited to attend; tea will be provided.

ON Tuesday next, Jan. 15, at 5.15, Dr. F. A. Freeth will begin a course of two lectures at the Royal Institution on critical phenomena in saturated solutions, and on Thursday, Jan. 17, Major Gordon Home delivers the first of two lectures on Roman London. The Friday evening discourse on Jan. 18, to be delivered by Sir William Bragg, will describe further progress in crystal analysis, and, on Jan. 25, Prof. A. C. Seward will speak on the vegetation of Greenland.

IN connexion with our article entitled "A Neglected Aspect of Scientific Research" (NATURE, Dec. 15, p. 913), it is of interest to know that the British Society for International Bibliography has recently been formed to deal with questions of classification. It is a daughter society of the Institut International de Bibliographie and has its headquarters at the Science Library, South Kensington, London, S.W.7, where the Brussels Decimal Classification is used. The honorary secretary is Mrs. S. M. Tritton.

RECENT issues of the *Daily Science News Bulletin* (by Science Service, Washington, D.C.) direct attention to the great epidemic of influenza which is spreading widely over the United States, and has also reached Canada. Cases of ordinary so-called influenza usually occur mostly in January and February, while 'epidemic influenza' occurs at any and all times of the year. This suggests that the present outbreak is one of epidemic influenza, the last visitation of which was in 1918.

MR. J. T. CUNNINGHAM writes to point out a mistake in the use of terms which occurs in a review by Prof. Karl Pearson in NATURE of Dec. 22, 1928, p. 955, column 2, line 7. Although the meaning of the passage was probably clear to most readers, Prof. Pearson is glad to have an opportunity of correcting the slip. What he intended to say was that "the lack of anterior pigment as judged by a lens is asserted to indicate that the individual has a truly blue eye; and will produce gametes carrying a recessive unit factor for blue. Two such lens-tested individuals will produce only true blue-eyed children."

THE latest catalogue of Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1, is No. 163. It gives the titles of upwards of 900 second-hand books of botanical interest, classified under the following headings: Herbals, early gardening, fruit culture, etc., prior to the year 1700; horticulture, gardening, fruit culture, etc., after the year 1700; botany, botanical travels, agriculture, etc., and cryptogams, plant pathology, etc.

MESSRS OGILVY AND CO., 20 Mortimer Street, London, W.1, have sent us a catalogue of shop-soiled and second-hand instruments and apparatus, mainly microscopical. Messrs Ogilvy have decided

to discontinue their second-hand department and in consequence are disposing of their second-hand stock, which includes a large and varied selection of microscopes and accessories and microscope preparations.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant at a Naval Experimental Establishment—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Jan. 12). A head of the Department of Pharmacy in the Bradford Technical College—The Principal, Technical College, Bradford (Jan. 15). A lecturer in physics and electrical engineering at the Handsworth Technical College—The Chief Education Officer, Education Office, Council House, Birmingham (Jan. 19). A science master at the Lawrence Royal Military School, Sanawar, India—The Secretary to the High Commissioner for India (General Department), 42 Grosvenor Gardens, London, S.W.1 (Jan. 19). A lecturer in civil engineering and building trades work in the Engineering Department of the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth (Jan. 25). A junior scientific officer under the Directorate of Scientific Research, Air Ministry, for research in applied physics, chiefly in connexion with aeronautical instruments—The Chief Superintendent, R.A.E., South Farnborough, Hants (Jan. 26). An investigator at the Mines Department Testing Station at Sheffield—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Jan. 28). A principal of the Government Technical School, Accra, Gold Coast—C.A. [T.], The Secretary, Board of Education, Whitehall, S.W.1. Scottish candidates —[T.], The Secretary, Scottish Education Department, Whitehall, S.W.1 (Jan. 28). An engineering assistant in the County Surveyor's Department of the Wilts County Council—The Clerk of the County Council, County Offices, Trowbridge (Jan. 28). A research assistant (botanical) and a research assistant (an entomologist) in the department of plant pathology of the Albert Agricultural College, University College, Dublin, for the investigation of virus diseases of plants—The Secretary, University College, Dublin (Jan. 31). A lecturer in physics in the University of Western Australia—The Agent-General for Western Australia, Savoy House, 115 Strand, W.C.2 (Jan. 31).

Our Astronomical Column.

ELONGATION OF MERCURY.—The easterly elongations of Mercury in spring are the most convenient and favourable of the year for observing this planet. They occur in 1929 on Jan. 22 and May 15, and the former will afford some excellent opportunities for viewing the planet from about Jan. 14 until Jan. 28. On Jan. 16 Mercury will set about 1¼ hr. after the sun, on Jan. 26 about 1¾ hr. later. It will be brighter before the date of elongation than afterwards, so that observations should be attempted during the third week of the month. It will be moving in an easterly direction amongst the southern stars, but at the close of January will appear stationary in the western region of Aquarius.

The times of setting and apparent brilliancy of the planet will be as follow :

	Mercury Sets (G.M.T.).	Apparent Stellar Lustre.		Mercury Sets (G.M.T.).	Apparent Stellar Lustre.
Jan. 14.	17h 38m	−0·74	Jan. 22.	18h 12m	−0·34
,, 16.	17 47	−0·70	,, 24.	12 16	−0·18
,, 18.	17 57	−0·62	,, 26.	18 18	−0·02
,, 20.	18 6	−0·50			

The brightness of the planet will therefore exceed that of such stars as Vega and Arcturus, and with a clear sky there should be little difficulty in detecting it.

REAL AND FICTITIOUS METEOR RADIANTS.—V. A. Maltzev of Leningrad contributes a paper on this subject to *Astr. Nachr.*, 5604. He quotes Dr. C. P. Olivier as saying that he was prepared to find that half the radiants in his catalogue did not correspond with real meteor streams. The rule adopted was that a radiant needed at least four meteors on the same night passing through a circle 2° in diameter to establish it.

Experiments were made at Leningrad by letting pins fall at random on a horizontal board graduated to correspond with a region of the sky extending over 90° in right ascension and 75° in declination. The point of the pin denotes the direction of motion. It would seem that very accurate horizontality of the board is necessary, otherwise the pins have a tendency to roll about their points. The conclusions drawn from the experiments are that more than half the published radiants are fictitious, and that more than 4 meteors through a 2° circle are required to establish a radiant. With a total of 100 meteors observed, it is considered that 11 meteors through a 2° circle are required. As the total number of meteors observed becomes less, the number required for a radiant slowly diminishes, being 8 when the total is 50, and 5 when it is 10. But 4 meteors will still suffice when the same radiant is confirmed by observations in other years on the same calendar date.

SAN LUIS CATALOGUE OF 15333 STARS.—The Carnegie Institution of Washington has just published this very useful catalogue. The late Prof. Lewis Boss felt the need of modern observations for many of the stars south of the equator in his Preliminary General Catalogue, and arranged that the Albany transit circle should be set up at San Luis, Argentina, so that the northern and southern observations should be obtained under as nearly as possible the same conditions, the observers being also the same. Prof. Tucker was in charge of the expedition, which worked so energetically that 87,000 observations were secured between April 1909 and January 1911. A series of photometric observations then commenced, which terminated in February 1913.

The reductions have been carried through with great care, the refractions being carefully studied. Stars were not observed both by reflection and directly at the same transit ; at Greenwich also it has been found advisable to abandon such double observations ; the second one being made in a hurry, after swinging the telescope through a large angle, was found to be subject to systematic errors. A comparison of both the Albany and San Luis catalogues with the P.G.C. shows that the two former agree very well with each other, but the systematic difference from the P.G.C. reaches 0·4″ in the neighbourhood of 20° N. Decl. There are many faint stars in the catalogue, some of mag. 10·4. Their positions are given for 1910·0 ; there is no discussion of proper motions.

Research Items.

PREFERENTIAL MARRIAGE IN SOUTH AFRICA.—In *Africa*, vol. 1, No. 4, Werner Erselen studies the conditions of marriage among the various races of South Africa in order to show that the property-family marriage entails a number of obligations on the interested parties. When marriage depends, as it does here, on a bride price, the desire of a young man for marriage, entailing payment of property which he has not yet had an opportunity to acquire, ceases to be a matter for the individual and brings in the family. The bride-price is provided by the family. This among the Bantu is in the form of cattle, their only wealth. The types of marriage are cross-cousin marriage, when the children of brothers and sisters intermarry, but the marriage of the children of sisters is forbidden; the sororate, when a man marries his deceased wife's sister, but it is the third and not the second sister who may thus be acquired; and marriage by inheritance when a man's wives are appropriated by his heirs—the principal heir being the eldest son, his own mother going to a younger brother of the deceased. These forms of marriage with their variations in detail are the natural result of a system of contract between two families based on the exchange of women for cattle or other property of equivalent value. Among the Xosa, where the levirate does not exist, a widow may either marry a stranger who repays the cattle originally paid with a discount for each child already born, and retained by the husband's family, or she has to stay with her husband's people. In the latter case children born as the result of intercourse with non-related men are looked upon as the legitimate children of her deceased husband.

THE IRON AGE IN ITALY.—In *Man* for December, Dr. Randall-MacIver discusses recent theory on the absolute chronology of the Early Iron Age in Italy, basing his argument on views recently put forward by Prof. Sundwall. This author holds (1) that the Villanovans were driven from Central Europe by climate change in the ninth century B.C.; and (2) that no painted pottery of Greek origin could come into Italy except via Cumae, and therefore sites on which it occurs must be later than 750 B.C. Against this view Dr. Randall-MacIver argues that, whatever the date of the climatic crisis, it does not fix the date of the migration, which may have taken place long before the final phase of hardship was attained. Further, other motives for migration may have been operative. As regards the second point, it is entirely disproved by recent excavations. The Greek pottery of Canale belongs to the eighth and ninth century, and is directly connected with the Dipylon schools. The sites, then, on which the pottery are found are therefore earlier, not later, than 750 B.C. Dr. Randall-MacIver's own dating places the First Benacci period at 1000 B.C. or earlier, Ducati brings it down to the ninth or eighth century. Dr. Randall-MacIver here makes two modifications. He accepts the rejection of his dating of 850 B.C. for the Warrior's Tomb at Corneto, though he thinks it cannot be later than the first half of the eighth century, and he now puts some of the Vetulonian tombs so late as 650 B.C.

ORIGIN OF THE FAUNA OF LAKE BAIKAL.—Lake Baikal in Siberia has always been considered to have a highly peculiar fauna, with a number of forms not occurring anywhere else. Recent investigations of fresh-water faunas of the northern hemisphere tend, however, to disprove that view, since many groups and species of animals which were regarded as endemic to Lake Baikal have been found elsewhere. Thus the genus of sponges *Baikalospongia* was found in a lake near the river Yenisei; amongst the Oligochæta, 13 species of the genus *Lamprodrilus* are peculiar to Baikal, but four more are now known in Europe and Siberia; a representative of another Baikal genus, *Teleuscolex*, has been discovered recently in Lake Okhrida in Macedonia; the genus *Propappus* (fam. Enchytræidæ) was known only from Baikal, but one species has been described from Elba and found afterwards in the Volga and other Russian rivers, as well as in Lake Baikal itself; amongst the Crustacea, the genus *Echinogammarus* is represented in Lake Baikal by 39 species, and there are four more species, namely, one in Lake Okhrida, one in the Faroë Islands, one in Tripolitania, and one in Spain, France, and Germany. The Baikal molluscan genus *Choanomphalus* is also represented in Lake Okhrida. An endemic Baikal diatom, *Gomphonema quadripunctata*, has been recently found in the Khanka Sea, near Vladivostok. Thus the idea of a very high endemism of the Baikal fauna seems to require a revision; the main endemic elements of the fauna are all of fresh-water origin, while there are no relics of an ancient marine fauna, as has been suggested by some authors. These facts lead L. S. Berg (*Comptes rendus*, Acad. Sci., Leningrad, No. 22; 1928) to conclude that the fauna of Lake Baikal has been derived from an upper tertiary fauna of fresh-water, or brackish-water, basins.

EMBRYOLOGY OF *STYLOPS*.—J. Noskiewicz and G. Poluszyński record (*Bull. Int. Acad. Polonaise Sc.*, Ser. B; 1928) observations on the embryology of the Strepsipteran *Stylops*. The egg is poor in yolk and the cleavage total and equal. During the fourth or fifth cleavage a nucleus is given off from one of the blastomeres into the central yolk mass, which is clearly delimited from the blastomeres and does not divide although its nucleus undergoes two divisions synchronous with those of the blastomeres. After the seventh cleavage the embryo consists of 120 or 124 blastomeres and a quadrinucleate yolk syncytium. About the fifth or sixth cleavage the embryo begins to be two layered and the end result of the cleavage is a morula in which the yolk sphere is peripheral. This stage is transient, for the cells soon assume a radial arrangement in a single layer with a peripheral yolk mass and a central cavity filled with a granular material secreted by the cells. The cells which lie under the yolk invaginate and thus a double-layered cup results. In the cavity of the cup is the yolk mass, the inner layer is the germ layer and the outer is the envelope, apparently equivalent to amnion + serosa of other insects. The germinal disc begins to elongate and the embryo becomes rolled at both ends, and stomodæum and proctodæum are formed. Cells proliferated from the end of the stomodæum gradually surround the yolk and form the mid-gut, which at a later stage has a tubular connexion with the fore-gut, but the proctodæum remains blind. The genital cells are differentiated moderately late as an unpaired mass of cells near the proctodæum.

FEEDING OF *AUTOLYTUS*.—Yo K. Okado (*Quart. Jour. Micr. Sci.*, Oct. 1928) describes the method of feeding of *Autolytus edwardsi*, as observed at Plymouth. This polychaet attacks the tentacles and upper portions of the hydranths of *Obelia*, cutting them off with the toothed tip of the chitinous tube of the protruded pharynx. The pumping action of the proventriculus, which has a valve at each end, causes the food to be

sucked through the pharynx and driven through the ventriculus (reduced in *Autolytus*) into the intestine. The pulsations of the proventriculus are about 120 per minute. The muscular elements of the proventriculus are strong columns, which extend radially from the lining epithelium, and slender semi-annular bands. Each radial column represents a single cell the major part of which consists of undifferentiated protoplasm (with one nucleus), on the periphery of which are the fibrils. In each fibril are four contractile zones, three internodes, and two insertion parts. The contractile zones only stain with hæmatoxylin, and may be compared with the anisotropic bands of the striated muscle of arthropods.

INDIAN HYDRACARINA.—A number of fresh-water mites have already been recorded from Ceylon and parts of India. Dr. C. Walter ("Zur Kenntnis der Mikrofauna von British Indien. II. Hydracarina," *Records of the Indian Museum*, vol. 30, pt. 1, 1928) describes a number of new species inhabiting marshy regions from a collection made by Dr. P. A. Chappuis for the most part from the Punjab and neighbourhood. All but one of these belong to known genera, the new genus *Testudacarus* being founded for one species based on one female only. Nearly half of the species recorded, however, are new. One of these, *Alurus scutelliformis*, has the hind legs armed with peculiar blade-like spines somewhat resembling the chelæ in certain annelids. Only one male and one nymph of this species were found. The paper is well illustrated by line drawings and there is a valuable list in tabular form showing the distribution of all the Hydracarina known from the Indo-Australian region, with a good survey of literature on the subject.

DEVELOPMENT OF *LEPTOSYNAPTA INHÆRENS*.—S. Runnström, in *Bergens Museums Årbok*, Heft 1, 1927, has an important paper dealing with the development of *Leptosynapta inhærens*. The biology is discussed. During the reproductive period the germ cells were shed between 3 and 6 P.M. daily for about a month. There were indications of periodicity in the reproductive activity. An account is given of cleavage, and a detailed study is made of the development of the mesoderm, nervous system, mesenchyme, and spicules. A barrel-shaped larva is produced. Comparison is made between this development and that of other Holothurians and consideration is given to the symmetry of the class and to the modifications of the *Synaptidæ*.

GENETICS OF THE DUTCH RABBIT.—Since 1920 an extended controversy has been taking place between Prof. Punnett and Prof. Castle regarding the genetics of the 'Dutch' rabbit. Prof. Punnett now returns to the charge armed with further breeding data (*Jour. of Genetics*, vol. 20, No. 2). These rabbits show a range of colour-marking from almost pure white to entirely black. Punnett interprets the condition as due to a major factor *P* producing the higher grades of pigmentation (and incidentally preventing *heterochromidia iridis*) and two minor factors *S* and *T* which are cumulative in effect, showing more pigmentation in the homozygous than the heterozygous condition. The typical Dutch pattern would be represented by *ppSSTT*. Another minor factor *N* occurs in most self-coloured breeds. Thus the whole colour series is explained by one major factor and three modifying factors. In place of *P*, Prof. Castle postulates three multiple allelomorphs, *Du* for self-colour, du_d for Dark Dutch and du_w for White Dutch, with certain modifying factors in addition. Castle also believes he has found linkage between Dutch pattern and long Angora hair, which Punnett believes is unproved. The English pattern has been shown by Castle to be closely linked with the Dutch; English × Dutch giving 3 : 1 ratios in F_2 except for rare cross-overs. The English rabbit has a factor for self-colour *plus* an inhibitory factor *I*, hence *IIPP* with certain minor factors. By matings with White Dutch, conclusions are drawn by Punnett which support his interpretations. The special value of this work lies in the analysis of what appears phenotypically as a more or less continuous series of colour patterns.

POST-EOCENE MOLLUSCA OF NORTH-WESTERN INDIA.—Nearly three years ago we directed attention (NATURE, Feb. 13, 1926, p. 246) to the publication of the first part of "Descriptions of Mollusca from the Post-Eocene Tertiary Formations of North-western India," by the late Dr. E. Vredenburg. Now, after inevitable delays, the second part has appeared under the editorship of Mr. H. M. Lahiri (*Mem. Geol. Surv. India*, vol. 50, pt. 2). It deals with the remainder of the Gastropoda and the whole of the Pelecypoda from the stratigraphical divisions distinguished by Blanford as the Nari, Gaj, and Mekran. Close on two hundred species, many being new, are carefully described, some in great detail, and figured from the author's photographs on 22 plates executed by the Survey in most admirable manner. There is a good index to the whole volume at the end.

SOUTHERN RHODESIAN MINES.—The Geological Survey of Southern Rhodesia has published in its *Bulletin* No. 13 a number of miscellaneous reports by Mr. F. E. Keep, State mining geologist. There are nine of these reports, five of them, namely, those on the Glen Hume and Glen Brook Gold Blocks, the Cactus mine, both in Gwelo district, the Lone Tree mine in Salisbury district, the Belvedere mine in the Belingwe district, the claims of the Parthenon Syndicate in the Hartley district being essentially gold mines; whilst there are also reports on the Belingwe antimony claims, upon the Copper Duke and Golden Duke mines in the Hartley district, upon Devitt's asbestos claims in the Selukwe district, and upon the Neardy mine in the Makoni district, which appears to carry copper and good lead ores. Apparently none of these mines is yet in a highly developed condition, and the reports, though extremely valuable for those locally interested in mining, cannot be said to be of any notable general importance.

SUPPORT OF UNDERGROUND WORKINGS.—The Safety in Mines Research Board has just issued Paper No. 45 dealing with the support of underground workings in certain of the more southern coalfields of England, including North and South Staffordshire, Cannock Chase, Shropshire, Leicestershire and South Derbyshire, Warwickshire, Forest of Dean, Bristol and Somerset, and Kent. The report gives a quantity of useful information, particularly in respect of the use of steel supports, the value of which is slowly beginning to be appreciated. A useful feature is a glossary of the mining terms employed; these differ so much in different parts of England that their inclusion is a distinct advantage, more particularly for those whose experience has lain in the other coalfields of Britain. There is a very useful summary of recommendations, some of which are deserving of the widest possible application, because a recommendation such as that "it is a good practice to keep in each district of the mine at least one day's supply of all lengths of timber in use," is a recommendation that might well be extended to all the coalfields of Great Britain, and the same may be said of many of the other recommendations; it is interesting to find that the authors of the report strongly recommend self-adjusting steel props both

for economy and safety, and also state that "when once steel arches are tried their use is generally extended." There is no doubt that the Committee of the Safety in Mines Research Board, which is studying the question of the support of underground workings, is one of the most useful that the Board has yet set up.

MADAGASCAR AND ITS OIL LANDS.—The mention of oil possibilities of certain countries conjures up all kinds of technical controversy, and it must be said that Madagascar, despite the Indo-Asiatic affinity attributed to it by Dr. A. Wade recently, prompts many conflicting impressions. If we admit that "geologically the island is an extension of the fundamental gneissic platform of Africa," which scarcely anyone would be prepared to gainsay, it is a little difficult to reconcile "every other point of view" with this Indo-Asiatic perspective drawn by that author during the course of his paper read before the Institution of Petroleum Technologists on Dec. 11 last. Most of the previous work on Madagascar has emanated from French writers, and it is certainly useful to have a modern English version by one who has spent considerable time in studying the geology of that island. But we feel that a more appropriate title for the paper would have been "The Geology of Madagascar," for the author scarcely makes out an encouraging case for its oil possibilities; he is, in fact, indicatively cautious in this connexion, his concluding remark being: "None can say that the island is devoid of possibilities in this direction." In so far as oil is concerned, seepages and tar sands occur at Triassic horizons; these overlie Permian beds with characteristic *Glossopteris* flora, in turn resting on the archæan platform. The whole sequence, in fact, is strongly reminiscent of south and south-east African stratigraphy, equally of parts of Asia, but scarcely of the oil-bearing regions of that continent. Most of the trials for oil seem to have been unsuccessful; prompted by the Pechelbronn operations, French engineers even had the idea of 'mining' some of the oil sands, but, unfortunately, there existed practically no pressure which would cause flowage, as the rocks were near the surface. Our impression is that Madagascar provides excellent territory for geological study, but that commercial possibilities of oil are somewhat remote.

CANADIAN FUELS.—The Mines Branch of the Canada Department of Mines has recently issued its report of "Investigation of Fuels and Fuel Testing for the year 1926" (Ottawa: F. A. Acland). The report indicates activities designed to promote the more efficient utilisation of fuels, accumulation of analytical data as to present and potential fuel resources, and actual experimental work to discover methods of exploiting fuels in the future. There is a draft of instruction for the proper burning of various fuels currently used in the domestic furnace, which requires a technique more exacting than the open grate. The analytical work has merely a local interest, but the study of the distillation of oil shales and the treatment of the Alberta bitumen sands has a wider interest. The crude bitumen extracted from the sand was in the form of a stubborn emulsion which was successfully resolved. It was shown that this bitumen formed promising stock for cracking by the Dubbs and Cross processes for the preparation of gasoline. This information is interesting, although the present low prices of crude mineral oil is a bar to development of such processes.

THE CORONA VOLTMETER.—It is well known that the maximum value of the potential difference between two spherical electrodes at the instant of the disruptive discharge can be computed with an accuracy of about one per cent, provided that the potentials of the spheres at the instant of the discharge are equal and opposite. This is one of the standard methods used by electrical engineers for measuring very high voltages. A more accurate method is by means of the corona voltmeter, the principle of which was first employed by Prof. J. B. Whitehead, of Johns Hopkins University. If two perfectly clean concentric metallic cylinders have a voltage applied between them, and if this voltage be gradually increased, then at a definite value the inner cylinder begins to emit light at its surface, ionisation can be detected and a characteristic sound can be heard. The beginning of breakdown can be detected by noticing any of these phenomena. A very thorough experimental study of the corona voltmeter by H. B. Brooks and F. M. Defandorf is published in the October number of the *Journal of the Bureau of Standards*. They find that except in noisy surroundings the aural detection method can be advantageously employed. Although a motor generator set was running in their laboratory, yet by using aeroplane headset telephones with a resistance coupled amplifier, they had no difficulty in making accurate measurements. Spark-over in a corona voltmeter must not be permitted. With aural detection the noise made is deafening, and the spark is injurious to the inner cylinder. The experiments show that when air at atmospheric pressure is used between the cylinders, then the ratio of their radii should not be less than twenty. For commercial work the corona voltmeter as at present constituted seems to be too complicated. Its accuracy, however, being in the neighbourhood of 5 in 10,000, leaves little to be desired.

FREQUENCY CONTROL BY QUARTZ OSCILLATORS.—In the United States, where there are very many broadcasting stations, great care has to be exercised in controlling the frequencies of the radio or carrier waves which they emit so as to avoid interference between them. When interference takes place, a high-pitched whistle which may spoil the programme is heard by the listeners. The Federal Radio Commission arranges so that the frequencies between any two stations always differ by more than 10,000 cycles. The difference frequency nominally, therefore, is not less than 10,000 cycles per second, and this 'beat' note is unobjectionable even if it could be heard. Few radio receivers could amplify, and fewer loud speakers could reproduce this note. In practice, however, it is very difficult to control the regulation sufficiently accurately to avoid beat notes. In the *Bell Laboratories Record* for September, a description is given of the principle of a device used by the Western Electric Co. to regulate the frequencies of the radio waves by means of quartz oscillators. The frequency of these oscillators depends on their thickness and their temperature. The variation of the period of vibration with temperature can be either positive or negative, depending on the cut of the crystal, and varies in amount from about 30 to 80 cycles per million per degree centigrade change in temperature. The crystal is ground until the desired frequency is approximately correct. The final adjustment is done by controlling the temperature at which the crystal operates. In practice the temperature of the crystal is maintained constant whatever the temperature of the room. The crystal is enclosed in a heat insulated box and the temperature of the interior is controlled by thermostatic means, the heating circuit being opened and closed by a vacuum relay. The frequency of a radio transmitter controlled thermally in this way is stated to be constant within a few parts in a million.

The South Africa Meeting of the British Association.

ARRANGEMENTS are now actively in hand for the meeting of the British Association in South Africa, in Cape Town and Johannesburg, next July and August, under the presidency of Sir Thomas Holland, rector of the Imperial College of Science and Technology. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Right Hon. Lord Rayleigh; Section B (Chemistry), Prof. G. Barger; Section C (Geology), Sir Albert Kitson; Section D (Zoology), Prof. D. M. S. Watson; Section E (Geography), Brigadier E. M. Jack; Section F (Economics), Prof. Henry Clay; Section G (Engineering), Prof. F. C. Lea; Section H (Anthropology), Mr. Henry Balfour; Section I (Physiology), Prof. W. E. Dixon; Section J (Psychology), Mr. F. C. Bartlett; Section K (Botany), Prof. A. C. Seward; Section L (Education), Dr. C. W. Kimmins; Section M (Agriculture), Sir Robert Greig.

Among the many subjects which are already under consideration for lectures and discussions it is probable that the relation between science and industry will take an important place, following upon the subject of Sir William Bragg's presidential address at last year's meeting in Glasgow. It is contemplated that discussions on this topic should be initiated at Cape Town and continued at Johannesburg by representatives in the principal departments of science concerned. A special programme is being arranged for geological members, in order that they may co-operate with the International Geological Congress which will be meeting in Pretoria concurrently with the Association in Johannesburg; and the agricultural members will be afforded opportunity for meetings with their colleagues in the Pan-African Agricultural and Veterinary Congress, which also will be sitting in Pretoria at the same time.

After the meetings the majority of the visiting members, who are expected to number upwards of 400, will divide into three main parties; each of these will visit the Victoria Falls, and two will afterwards make extended journeys through the Union territory, visiting the eastern Transvaal and Lourenço Marques, in Portuguese East Africa, and terminating their journeys at Durban and Cape Town, respectively. The third main party will probably proceed from the Victoria Falls to Beira, visiting en route the ruins at Great Zimbabwe, where it is hoped that Miss Caton-Thompson will have brought to a successful issue the investigation of the ancient remains which she is about to undertake at the instance of the Association.

The sectional organising committees held their usual joint meetings at King's College, London, on Jan. 4, when a number of important subjects were brought under consideration for joint meetings of various sections in South Africa. Among these was a general discussion on the conception of life, which it was proposed should be opened by General Smuts. Other discussions are expected to deal with problems of special interest to South Africa, such as those connected with deep mine ventilation and with the relation of dust to miners' diseases. The geologists, zoologists, and botanists expect to be associated in a discussion on Gondwanaland. Educational problems to be discussed include psychological tests in relation to education and vocational guidance, and the teaching of geography, both of which are understood to be of special interest to South African educationists at the present time. A discussion on vitamins is contemplated between the chemical and physiological sections.

The South African Association for the Advancement of Science, which initiated and forwarded the invitation to the British Association and, through an executive committee, is undertaking the arrangements in South Africa in co-operation with the Travel and Tourist Branch of the South African Railways, has issued special invitations to certain distinguished Dutch and other foreign scientific representatives, of whom the following have accepted: Prof. E. J. Cohen, Prof. W. de Sitter, Prof. G. A. F. Molengraaf, Prof. R. Casimir, Prof. O. Abel, M. l'Abbé Breuil, Prof. C. Dragoni, and Prof. A. S. Hitchcock

Science Masters' Association.

CAMBRIDGE MEETING.

THE twenty-ninth annual meeting of the Science Masters' Association was held at Cambridge on Jan. 2–5. The members were accommodated partly in Trinity College, partly in Gonville and Caius. The deputy vice-chancellor, master of Sidney Sussex College, heartily welcomed the Association to Cambridge. The president—Prof. A. C. Seward, master of Downing College—delivered his presidential address on "The Flora of the Carboniferous Period."

As is usual on these occasions, when the Association goes to one of the university towns, many topics which do not appear in the programme were discussed informally. Prof. Seward broached one of these in the preface to his address, namely, the need for more botanists. There has probably never been a time when the demand for trained men in all branches of science has been either so great or so varied as it is to-day. The staple product, namely, mental ability, is in the schools in quality and quantity sufficient to meet all demands; the willingness to develop it in the best possible way is also there, but somehow the available talent is not being so economically distributed as both schoolmasters and university teachers would wish. There are too many potential chemists, not enough biologists, and extremely few geologists.

The pressing need of the moment is biologists, and especially pure botanists, and what makes matters worse in this branch is that the already inadequate supply is being depleted to some extent by the claims of forestry, which naturally encroaches more on botany than on zoology.

"It would be foolish," said Prof. Seward, in his opening remarks to more than four hundred science masters, "not to seize this exceptional opportunity of asking for sympathetic co-operation in an endeavour to meet a very pressing need. In recent years it has been impossible to satisfy demands from Government Departments and from various other quarters for men qualified to fill administrative and research posts requiring more than an elementary acquaintance with botany. At Cambridge we have plenty of men who take botany as one of three subjects in the first part of the Natural Science Tripos, but there is a shortage of men of first-rate ability who choose botany as the one subject in the second part of the Tripos.

"I have recently circulated a memorandum to tutors and directors of studies drawing attention to the great increase, during the last few years, in the number of well-paid and attractive posts in the Dominions, the Colonies, and at home, which cannot be satisfactorily filled because of the lack of suitable candidates. May I entreat my colleagues who advise

boys on the selection of subjects at the university to assist, not so much the Cambridge Botany School as the Empire as a whole, by encouraging promising pupils to consider the possibility of making an acquaintance with botany as an alternative to choosing what, to many, would be a more familiar and therefore an easier course—the further study of chemistry, physics, and mathematics ?

"This request is made partly because, in my opinion, a man who takes a degree in science should have some knowledge of a biological subject, but primarily because I am convinced of the vital importance of turning out men who can supply one of the greatest needs of the present day by devoting themselves to the investigation of problems which lie at the root of our national prosperity. There are, no doubt, many boys whose mental chords are more responsive to the calls of mathematics, physics, or chemistry than to those of biology : the trouble is a disinclination on the part of some schoolmasters to admit the probability that not a few of their pupils who have shown themselves to be competent students on the physics side might, given an opportunity, discover that biology is their destiny. The safe course at the university, it may be said, is a continuation of that followed successfully at school. I recall a Spanish saying : 'Go with God, Your Grace, and may nothing new happen.' On the other hand, it is perhaps desirable to encourage self-determination, to give all a chance of experiencing the joy of entering a new world, the thrill of a novel quest."

Prof. Seward also put in a plea for a little more geology, an extremely modest plea considering the importance of the subject and the fascination that it has for many boys. "I dare not suggest the addition of geology to an already overburdened curriculum, though I cannot help thinking that more effort might be made to bring boys into touch with this branch of natural knowledge, either by devoting part of a general elementary course in science to geological talks, or, in suitable districts, by encouraging boys to spend some of their free time, if they have any, in making observations for themselves, in collecting fossils—a by no means contemptible occupation—or by studying the more obvious phenomena connected with erosion and rock-building which provide clues to the interpretation of the documents from which geological history is compiled."

A little more autonomy in school certificate and matriculation examinations, or even a little more elasticity in examinations, would do a great deal towards equalising matters. University authorities are apt to blame advanced courses in schools, but the trouble begins with the school certificate, which is also the first statutory examination of a boy's university career. If he gets credit in chemistry and physics in the school certificate, he is entitled to think he has done something in those subjects and he is reluctant to make a fresh start for the higher certificate ; consequently, he does (as he sometimes puts it) chemistry and physics again. When he gets to the university, he is still more reluctant to strike out on entirely new lines.

When the Science Masters' Association meets, as it does, in alternate years at one of the universities—old or new—the members get what is in reality a short but intensive refresher course, relieved by very pleasant social intercourse. University professors and lecturers are astonishingly generous in providing most stimulating lectures, the laboratories and museums are all thrown open, visits to works and attractive demonstrations are arranged. The latest useful devices for aiding science masters in their work and the newest books are brought to their notice in the manufacturers' and publishers' exhibition. It is difficult to appraise the value of conferences, because they vary so much both in utility and in achievement, but whatever may be said in mild disparagement of the conference habit—the 'talker feast,' as our American colleagues put it—there is no doubt that these meetings of the Science Masters' Association are most stimulating and a powerful antidote to that bane of the schoolmaster's work—stagnation.

The next meeting of the Association will be held in London, in January 1930, under the presidency of Prof. James C. Philip, professor of physical chemistry in the Imperial College of Science and Technology.

Whales Landed in Scotland.

PROF. D'ARCY W. THOMPSON has written a most interesting account of the whales landed at the Scottish whaling stations during the years 1908–14 and 1920–27 (*Fishery Board for Scotland : Scientific Investigations*, 1928, No. 3), including a detailed examination of all the records, illustrated by sketch maps showing the place of capture, and by tables and diagrams, as well as a full bibliography of references to the species.

The old Scottish industry was almost at an end when in 1903 the harpoon-gun was introduced from Norway and gave a new impetus to whaling. The harpoon-gun was used in Ireland a hundred years before its re-invention by Captain Svend Foyn about 1865. It is apparently, however, not the harpoon-gun alone which has made the modern whaling industry, but the gun used with the explosive bullet.

A system of licences was introduced in 1908, and full records with measurements are kept of all whales captured. Thus a large amount of valuable information is available on which the present paper is based. 6817 whales were landed in Shetland and Harris from 1908 to 1927 (excluding the years of the War, and 1919 and 1921, when no whaling was conducted). Seven species are represented, the Common Finner, *Balænoptera musculus*, being the commonest, the Bottlenose, *Hyperodon rostratus*, the rarest. In between in order of frequency come the Sci-whale, *Balænoptera borealis*; the Blue whale, *B. Sibbaldi*; the Sperm whale, *Physeta macrocephalus*; the Nordcaper, *Balæna biscayensis*; and the Humpback, *Megaptera longimana*.

Of these the Nordcaper or 'Sarde,' the whale of the old Basque fishery, is one of the most interesting. For some time it was thought to be extinct, but although never taken in numbers, 69 individuals, 35 males and 34 females, have been captured since 1908, nearly all of which have been landed at the whaling station at Bunaveneader and caught within an area lying to the west and south-west of the Hebrides and beyond St. Kilda. Most of these were taken in 1908 and 1909, and it is shown that there are very definite fluctuations in their occurrence, apparently dependent on variations in Gulf Stream water. In those years when the Atlantic overflow to the north-east is strongest these whales are scarce and vice versa, probably owing to their tendency to linger on the coasts of Britain when there is little Gulf Stream current to carry them northwards.

75 Sperm whales are recorded, all but one being males. They do not breed in Scottish waters, and it is thought that these were young bulls which had

been driven out of the herd. It is a remarkable fact that the Sperm whales caught in 1911 (when this species was exceptionally numerous) were all very fat, whilst those caught in 1909 and 1912 were very lean, and the Nordcapers caught in 1909 and 1912 showed the same leanness; and yet the diet of the Sperm whale is mainly cuttlefishes, and that of the Nordcaper consists of the smaller planktonic organisms.

University and Educational Intelligence.

CAMBRIDGE.—A bequest of the value of about £250,000 from the late Mr. John Humphrey Plummer, of Southport, is announced. The money is to be governed by trustees and is for the endowment of two chairs for the promotion of modern scientific research. No details are as yet available as to the conditions governing the trust.

LONDON.—The following courses of free public lectures, without tickets, are announced: "Fatigue," by G. P. Crowden, at University College, on Jan. 14, 21, and 28, at 5; "The Physiology of Reproduction," by Dr. A. S. Parkes, at University College, on Jan. 16, 23, 30, and Feb. 6, 13, and 20, at 5; "The Chemistry of Some Natural Drugs," by Dr. H. R. Ing, at University College, on Jan. 17, 24, 31, Feb. 7, 14, and 21, at 5; "Comparative Physiology," by C. F. Pantin, at University College, on Jan. 18, 25, Feb. 1, 8, 15, 22, Mar. 1, 8, 15, and 22, at 5; "Some Applications of Physical Chemistry to Steel Manufacture," by Dr. A. McCance, at the Imperial College of Science—Royal School of Mines, on Jan. 23, 24, 30, and 31, at 5.30; "Cytology in Relation to Physiological Processes," by Dr. R. J. Ludford, at University College, on Jan. 24, 31, Feb. 7, 14, 21, and 28, at 5; "The Current Work of the Biometric and Eugenics Laboratories [University College]," by Prof. Karl Pearson and others, at University College, on Jan. 29, Feb. 5, 12, 19, 26, and Mar. 5, at 5.30.

MORE than a hundred bibliographies of various subjects have now been issued by the National Book Council, 3 Henrietta Street, London, W.C.2. These lists of books do not profess to be exhaustive, but each is prepared under the auspices of a body competent to express an opinion on the subject with which a particular list deals. One of the latest lists (price 2*d.*) contains the titles of recommended books on popular science, or introductory to the various branches of science, and is compiled by Mr. J. B. Clark, late headmaster of George Heriot's School, and approved by the National Home-reading Union. The list is classified by subjects, and publisher, date, and price are given for each volume. It should be a valuable guide to the general reader who wishes to keep in touch with the progress of modern science.

A HARVARD-YENCHENG Institute of Chinese Studies is to be opened under the supervision of nine directors representing Harvard and Yencheng (Peking) Universities and the estate of the late Charles M. Hall of Niagara Falls, New York, who provided an endowment of two million dollars for it. The work of the Institute, which will be carried on at both universities, will include research in Chinese history, art, literature, philosophy, and religion, and special attention will be paid to the study of the Chinese language as a key to understanding the history and civilisation of China. There are already some fourteen hundred Chinese students in the United States, and numerous scholarships tenable in the United States are provided by the Chinese Educational Mission, while large sums are spent in promoting study and research by Americans in China. The new Institute will obviously strengthen the intellectual ties between the two countries.

Calendar of Patent Records.

January 14, 1822.—The lawyer's wig claims its share of the inventor's attention. On Jan. 14, 1822, there was granted to H. W. Ravenscroft, of Lincoln's Inn, peruke maker, a patent for his "forensic wig, the curls of which are constructed on a principle to supersede the necessity of frizzing, curling, or using hard pomatum; and for forming the curls in a way not to be uncurled; and also for the tails of the wig not to require tying in dressing, and further the impossibility of any person untying them."

January 15, 1820.—During the first hundred years of their existence, pianos, like spinets and harpsichords, were constructed entirely of wood, though the advantages of being able to use thicker and heavier strings had induced many attempts to introduce iron into the frames. William Allen, a tuner, and James Thom, the foreman, at Stodart's, one of the leading piano-makers in London, were the first to devise a satisfactory solution to the problem, and a patent was granted to them for their iron-frame construction on Jan. 15, 1820. The patent rights were at once bought by Stodart's and a great step forward towards the modern piano was made.

January 15, 1910.—The unsplinterable glass known as 'triplex glass,' which consists of two sheets of glass united by sticking between them a sheet of celluloid softened by a solvent such as acetone and subjecting them to considerable pressure, was invented by Édouard Benedictus of Paris. His French patent was applied for in August 1909, and the printed specification describing the invention was published on Jan. 15, 1910. The British patent was applied for a few days later and antedated to the date of the French application.

January 18, 1799.—The continuous papermaking machine was invented by Louis Robert, a mechanic in the employ of Didot St. Leger, paper manufacturer of Essones, France, a French patent being granted to him on Jan. 18, 1799. The French patent rights were assigned to Didot, but the practical application and development of the invention were due to the Fourdriniers of London, who had acquired the English rights from the patentee, John Gamble. Although an Act of Parliament was obtained extending the life of the patent to the year 1822, the patent was hotly contested and was finally set aside by the courts on a technical flaw, and the Fourdriniers lost not only their royalties but also the very considerable sum of money they had spent in perfecting the invention.

January 20, 1818.—The great tunnel enterprises of recent years were made possible by the invention of the tunnel boring-shield by Marc Isambard Brunel, the patent for which is dated Jan. 20, 1818. Brunel's shield—the general principles of which are the same as those of the shields in use to-day—was employed for the first time in 1825 for the construction of the Thames tunnel at Rotherhithe, which after long delays due to financial difficulties was finally completed and opened to the public in 1843. No other shield tunnel was built until 1869.

January 20, 1820.—Labour-saving devices have generally had their origin in the United States, and it was here that the standardisation of parts in gun-making and their manufacture on the interchangeable system was worked out and fully developed. One of the principle inventors in this field was Thomas Blanchard, a descendant from a Huguenot family which settled in Boston in the seventeenth century. The United States patent for his lathe for turning gun-stocks was granted on Jan. 20, 1820, and such was its importance that it was twice extended by Act of Congress, first in 1834 and again in 1848.

Societies and Academies.

LONDON.

Geological Society, Dec. 5.—**K. S. Sandford**: The erratic rocks and the age of the southern limit of glaciation in the Oxford district. The Plateau Drift around Oxford contains rocks brought from long distances: from Scandinavia, Scotland, East Anglia, the Midlands, and, most surprising of all, from Devon and Cornwall. The Drift entered the district through the Cotswold escarpment by gaps which the northern tributaries of the Upper Thames occupy. There is no evidence of glacial erosion of the district within the scarp, though a few patches of Drift are recognised as Boulder Clay. It is not suggested that heavy glacier-ice was the vehicle in every instance: for example, the material from the south-west was most probably carried on detached shore-ice drifting up the Bristol Channel. This material lends support to the view that the southern midlands in particular were submerged to a considerable depth. The material, however introduced, was 'graded' or redeposited in terraces up to 350 feet above the recent rivers, this process being subsequent to, and distinct from, the introduction of the Drift into the district. The erratics are believed to have been assembled under glacial conditions, evidently over a long interval of time, early in the Pleistocene Period. Within the district a threefold glacial sequence is now established. The first, the subject of this paper, was the maximum glaciation of the southern midlands and of early Pleistocene age. During the other two the district was an ice-free land-area, between the glaciers of the eastern counties and of Wales. The Oxford district being ice-free during these later glacial episodes, the conditions which then prevailed are faithfully recorded in the contemporary fluviatile deposits and surface-changes. The chronological sequence is given.

Royal Meteorological Society, Dec. 19.—**L. H. G. Dines**: The Dines float barograph. The instrument designed by the late Mr. W. H. Dines about twenty years ago, which has been in use at the observatories of the Meteorological Office for a number of years, is a pen-recording barograph of which the leading feature is the care taken to reduce friction in the mechanism. The record will indicate barometric oscillations of amplitudes down to one or two tenths of a millibar.—**J. Glasspoole**: The distribution of the average seasonal rainfall over Europe. In western Europe there is abundant rain at all seasons, with a minimum in summer and a maximum in winter. In the Mediterranean region there is very little rainfall at all during the summer, while there is generally a preponderance at this season in central Europe. In the three months June–August only one-fiftieth of the average annual rain falls in the south of Spain, while more than half the annual amount falls in the same period in north-eastern Russia.

PARIS.

Academy of Sciences, Dec. 3.—Camille Gutton was elected *Correspondant* for the Section of Physics, and Louis Léger for the Section of Anatomy and Zoology.—**Long**: A property which appears to belong to prime numbers.—**Herbert Ory**: The equation $x^n = a$, where a is a square-determinant of the second order.—**B. Hostinsky**: The probabilities relating to the position of a sphere with fixed centre.—**C. Lurquin**: A limit of probability in the Bienaymé-Tchebycheff sense.—**Vladimir Bernstein**: Some theorems on the growth of holomorph functions and the series of Dirichlet.—**Paul Lévy**: The symbolic calculus of Dirac.—**F. H. van den Dungen**: The approximate calculation of the fundamental numbers.—**A. Zygmund**: Conjugated functions.—**Alexandre Rajchman**: A class of functions with limited variation.—**Henri Bénard**: Alternating vortices (in liquids) due to knife-edge obstacles.—**J. Haag**: Extension of the theory of Saint-Venant to elastic wires of any form.—**R. de Fleury**: Aluminium pistons. It has been noted that the substitution of aluminium pistons for iron pistons in internal combustion engines leads to a marked increase in the wear of the cylinder. The possible causes of this are discussed.—**Thadée Peczalski**: The kinetic theory of adsorption.—**Mlle. Marie Kosinska**: The Joule-Thomson effect and the internal friction of fluids.—**Vasilesco Karpen**: The Van der Waal's equation and the principles of thermodynamics. The Maxwell-Clausius relation and the formula of Clapeyron deduced from this equation.—**Edgar Pierre Tawil**: A new mode of developing electricity by torsion in quartz crystals.—**Albert Arnulf**: An optical method of localisation of polished surfaces, and its application to the measurement of radii of curvature.—**V. Posejpal**: The fluorescence of benzene and its infra-red absorption.—**H. Barjot**: Utilisable natural energy. In regions within the Arctic Circle the atmospheric temperature may be from $-25°$ C. to $-40°$ C., whilst ice-covered lakes have water immediately under the ice layer at 0° C. A heat engine with ammonia, carbon dioxide, or sulphur dioxide as working liquid could be worked over this range and used as a source of energy.—**Albert and Marcel Gosselin**: Constitution and thermochemistry.—**Charles Prevost**: Some new phenomena of tautomerism in the allyl series. Study of the phenomena of tautomerism between compounds of the types $C_2H_5 \cdot CHX \cdot CH : CH_2$ and $C_2H_5 \cdot CH : CH \cdot CH_2X$.—**J. Orcel**: Remarks on the measurement of the reflecting power of opaque minerals and of highly refractive transparent minerals. A completion of an earlier paper on the same subject with additions on the choice of standard minerals and on the calculation of ω, the angle of maximum rotation of the plane of polarisation of the incident light.—**Paul Gaubert**: The action of heat and of the loss of water on the optical properties of heulandite. An attempt is made to determine the separate effects of rise of temperature, loss of water, and optical anomalies.—**Maurice Blumenthal**: The existence of the Malaga Betic in the region of Grenada.—**A. Demay**: The prolongation of the Cevennes strata on the western border of the Saint-Etienne coal basin.—**Pierre Viennot**: New geological observations in the Labourd (Basse-Pyrénées).—**Jacques Bourcart** and **Guy Le Villain**: The fauna of the Cambrian limestones of Sidi Mouça d'Agloa, near Tiznit (South Morocco).—**Gustave Rivière** and **Georges Pichard**: The fertilisation of soils poor in lime. Comparative trials with various carbonates. A description of experiments on the effects of the addition of carbonates of calcium, magnesium, sodium, and potassium to soils, equimolecular proportions being employed. In each case the yield of oats was increased, the most marked effect being produced by sodium carbonate, which appeared to act as a true manure.—**A. Mordvilko**: New contribution to the study of anolocycly in the Aphides. *Forda formicaria* and its anocyclic form.—**Alphonse Labbé**: The experimental production of conjunctive tissue by the amæbocytes in *Doris tuberculata*.—**J. J. Thomasset**: An attempt at the classification of the varieties of dentine in fishes.—**André Boivin**: Contribution to the study of the chromic-sulphuric acid oxidation of carbonaceous substances. A general method for the micro-estimation of carbon in the wet way. The modifications suggested are a temperature

of 100° C. for the moist combustion and a means of burning the carbon monoxide always produced.—**E. Brumpt**: The identity of the genera *Grahamella* and *Bartonella*.—**Georges Blanc** and **J. Caminopetros**: Experiments made in Greece on the mode of transmission of dengue. Attention is directed to the fact that the word 'dengue' has been applied to two separate diseases. The mosquito *Stegomyia* is infected by the disease and can transmit it in the usual way; mosquitoes of the genus *Culex* do not pass on the infection by stinging.—**Et. Burnet, P. Durand,** and **D. Olmer**: Attempts at the transmission of Marseilles exanthematic fever by lice. Attempts to infect apes through the medium of lice gave negative results.

Official Publications Received.

BRITISH.

Madras Agricultural Department. Year Book, 1927. Pp. ii+48+5 plates. 10 annas. Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1927-28. Pp. ii+103+4+6 plates. 1 rupee. Bulletin No. 92: Mosaic Disease of Sugar Cane. By Rudolph D. Anstead. Pp. 13+2 plates. 6 annas. Bulletin No. 93: Cultivation of Plantains on Wet Lands in the Godavari Delta. Pp. ii+8+1 plate. 2 annas. (Madras: Government Press.)

South Australia: Department of Mines. Mining Review for the Half-Year ended June 30th, 1928. (No. 48.) Pp. 70+9 plates. (Adelaide: Harrison Weir.)

Tide Tables for the Eastern Coasts of Canada for the Year 1929: including the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits; and Information on Currents; in addition to Tide Tables for New York and Boston, U.S.A. (Thirty-third Year of Issue.) Pp. 90. (Ottawa: F. A. Acland.)

Transactions of the Geological Society of Glasgow. Vol. 18, Part 2, 1927–1928. Pp. 247-360. (Glasgow.) 7*s.* 6*d.*

City of Leicester Museum and Art Gallery. Twenty-fourth Report to the City Council, 1st April 1927 to 31st March 1928. Pp. 24. (Leicester.)

London School of Hygiene and Tropical Medicine. Report on the Work of the School for the year ended July 31st, 1928. Pp. 32. (London.)

FOREIGN.

University of Illinois Engineering Experiment Station. Bulletin No. 185: A Study of the Failure of Concrete under combined Compressive Stresses. By Prof. Frank E. Richart, Anton Brandtzaeg and Rex L. Brown. Pp. 104. 55 cents. Bulletin No. 186: Heat Transfer in Ammonia Condensers, Part 2. By Prof. Alonzo P. Kratz, Prof. Horace J. Macintire and Richard E. Gould. Pp. 28. 20 cents. (Urbana, Ill.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 10, Part 1: Amphibians and Land Reptiles of Porto Rico, with a List of those reported from the Virgin Islands. By Karl Patterson Schmidt. Pp. 160+4 plates. (New York City.)

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 14: Land-Grant Colleges and Universities, Year ended June 30, 1927. By Walter J. Greenleaf. Pp. v+77. (Washington, D.C.: Government Printing Office.) 15 cents.

Japanese Journal of Physics: Transactions and Abstracts. Vol. 5, No. 1. Pp. 66+14+2 plates. (Tokyo: National Research Council of Japan.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. Land Shells of Tortuga Island, Haiti, and a new Haitian Oleacina, by Henry A. Pilsbry and Edward G. Vanatta; Review of the Species of Lucidella belonging to the Subgenus Poeniella (Helicinidae) of Haiti and Santo Domingo, by Henry A. Pilsbry. Pp. 475-482+plate 27. (Philadelphia, Pa.)

CATALOGUES, ETC.

Rare Books. (Catalogue No. 23.) Pp. 58. (Newcastle-on-Tyne: William H. Robinson.)

Calendar for 1929. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Nickel Steels, Series A, No. 2: The Properties and Applications of Invar and related Alloys. By C. E. Guillaume. Translated by R. Rengert. Pp. 8. (London: The Bureau of Information on Nickel, Ltd.)

Calendar for 1929. (London: Cambridge Instrument Co., Ltd.)

Calendar for 1929. (London: *The Chemical Trade Journal.*)

Récentes publications médicales. Pp. 64. (Paris: Masson et Cie.)

Diary of Societies.

FRIDAY, JANUARY 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.—T. Royds: A Very High Prominence on Nov. 19, 1928.—J. M. Baldwin: Alignment Chart Connecting Position Angle and Distance of the Apex of the Sun's Way and Galactic Co-ordinates with Equatorial Co-ordinates.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—L. C. Wharton: Dialect Developments.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.—E. Ashby: Taxonomic Value of Characters in the Order Polyplacophora.—C. Oldham: *Cepœa hortensis* Mull. and *Arianta arbustorum* L. on Blown Sand.—Dr. H. Engel: *Aplysia* (*Tethys*) *dactylomela* Rang, a Circumtropic Species.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—W. J. Drummond: Coal used in its Raw State.—Dr. W. T. K. Braunholz: Fuels obtained by the Treatment of Coal.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—J. A. H. Lloyd: Telephone Repeaters.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. F. C. Wood: Recent Progress in the Study of the Chemical Reactions of Cellulose.—N. S. A. Humphries: The Efficiency of the Present Day Finishing Stenter.—F. Schofield: A New Oxygen Carrier for Dyeing and Printing Processes.—Dr. G. N. Burkhardt and H. Wood: The Nitro-Aryl-Sulphuric Acids and their Reduction Products.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. E. Webb: Developments in Spraying Apparatus.

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7.30.—Dr. P. Bean: The Dyeing of Artificial Silk.

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café, Keighley), at 7.30.—Lecture on Artificial Silk.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea), at 7.30.—A. Grounds: Preparation of Coal for the Market.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Royal Society of Arts), at 8.—Prof. B. P. Haigh: The Relative Safeties of Mild and High-Tensile Alloyed Steels under Alternating and Pulsating Stresses.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—M. L. Hepburn: An Attempt to Classify (Pathologically) the Various Fundus Pictures in Diseases of the Choroid.—M. S. Mayou: Juvenile Glaucoma.

MONDAY, JANUARY 14.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Col. Sir Gerald Lenox-Conyngham: The Cambridge Pendulums for Gravity Survey.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: A Sketch of the Present State of Knowledge regarding the Evolution of the Brain in Higher Primates.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Dr. F. W. Lanchester: Coil Ignition.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Loughborough College), at 7.—E. C. Thompson: Purchasing.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College), at 7.—Capt. J. M. Donaldson, J. G. Hines, and others: Discussion on The Anticipation of Demand, and the Economic Selection, Provision, and Layout of Plant.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Major A. Jenkin and others: Discussion on Electric Trolley Omnibuses.

CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—G. W. S. Brewer: Pre-wheel Pottery—Descriptive of Iron Age Remains from Cleeve Hill, Cheltenham.—K. Silk and N. D. Wood: The Comparative Effects on Earthenware Slip of Varying Soda-silica Ratios in Silicate of Soda.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Branch) (London and District) (at Borough Polytechnic), at 7.30.—A. T. Henly: Timber Drying and Seasoning.

HUNTERIAN SOCIETY OF LONDON, at 7.30.—Prof. Putti: Lecture.

INSTITUTE OF METALS (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 7.30.—A. Spittle: Recent Developments in the Manufacture of Condenser Tubes.

INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—J. Stewart: The Malting Barleys of 1928.

TUESDAY, JANUARY 15.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. F. Parkes Weber: Endocrine Tumours.—Dr. O. Leyton: How can we Decide that a Case of Glycosuria Should be Treated?

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. F. A. Freeth: Critical Phenomena in Saturated Solutions (I.).

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

MINERALOGICAL SOCIETY (at Geological Society of London), at 5.30.—Prof. A. Holmes and Dr. H. F. Harwood: The Tholeiite Dikes of the North of England.—A. Russell: On the Occurrence of Gold at Hope's Nose, Torquay, Devonshire.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Derby Technical College), at 6.45.—F. H. Rosencrants: Practice and Progress in Combustion of Coal as applied to Steam Generation.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—J. L. Carr: Recent Developments in Electricity Meters, with Particular Reference to those for Special Purposes.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. E. B. Wright: Rock Climbing in the English Lake District.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Branch) (Manchester and District) (at Milton Hall, Manchester), at 7.—L. Barton: Ventilation of Institutions and Public Buildings.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—R. Dowson: Some Aspects of Steam Turbine Development and Application.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—Roger Fry: Representation in Art (Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. R. R. Gates: Studies of Eskimos and Indians in the Canadian Arctic.

INSTITUTION OF MECHANICAL ENGINEERS (Swansea Branch).—J. W. Burr: The Electrification of a Small Railway.

WEDNESDAY, JANUARY 16.

SOCIETY OF GLASS TECHNOLOGY (at Manchester), at 2.30.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.—Clinical Pathological Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Growth of the Human Brain, and a Discussion as to the Significance of its Mass.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—H. H. Dalrymple-Hay: Merits and Demerits of Alternative Methods of taking Water for Modern Power-Stations from Tidal Waters.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (jointly with Liverpool Engineering Society) (at Liverpool), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Section) (at Cleveland Technical Institute, Middlesbrough), at 7.—S. G. Marston, D. G. F. Drummond, and others: Informal Discussion on The I.E.E. Wiring Regulations.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institute of Chemistry), at 7.15.—W. P. Dreeper: Artificial Silk (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—H. Caird, W. S. Paulin, and others: Discussion on Steam Engine Machinery versus Diesel Machinery.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—T. W. Sampson: The Electrical Engineer and Medical Science.

JUNIOR INSTITUTION OF ENGINEERS (Sheffield and District Local Section) (at Cutlers' Hall, Sheffield), at 7.30.—Lt.-Col. J. T. C. Moore-Brabazon: Early Aviation.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. Spittle: Recent Developments in the Manufacture of Condenser Tubes.

TEXTILE INSTITUTE (Yorkshire Section, jointly with Halifax Textile Society) (at White Swan Hotel, Halifax), at 7.30.—A. Saville: Some New Factors in Industry.

ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.40.—Presentation of the Buchan Prize to Dr. Harold Jeffreys.—Sir Richard Gregory: Amateurs as Pioneers (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: The Domestic Smoke Problem—a Practical Solution.

ROYAL MICROSCOPICAL SOCIETY (Annual General Meeting), at 8.—J. E. Barnard: Some Aspects of Ultra-Violet Microscopy (Presidential Address).

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology, Leicester), at 8.—J. P. O'Callaghan: Present-day Methods of Water Softening.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—D. J. Macnaughtan and R. A. F. Hammond: The Progress of Nickel Deposition in Recent Years.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College).—S. A. Wikner: Tar Distillation.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section).—F. G. Conyers: The Distillation of Wood.

INSTITUTE OF CHEMISTRY (Huddersfield Section).—Spiropyans and the Formation of Coloured Ions.

THURSDAY, JANUARY 17.

ROYAL SOCIETY, at 4.30.—Prof. A. S. Eddington: The Charge of an Electron.—R. H. Fowler: The Thermionic Emission Constant A.—J. A. Gaunt: The Triplets of Helium.—G. Temple: The Tensorial Form of Dirac's Wave Equations.—*Papers to be read in title only*:—Prof. H. M. Macdonald: The Reflexion and Transmission of Electric Waves at the Interface between two Transparent Media.—D. K. Bhattacharyya: On the Analysis of the First Spark Spectrum of Sulphur.—C. W. Gibby, C. C. Tanner, and Prof. I. Masson: The Pressure of Gaseous Mixtures (II.).—J. S. Foster: Effect of Combined Electric and Magnetic Fields on the Helium Spectrum.—R. W. B. Pearse: The Ultra-Violet Spectrum of Magnesium Hydride (I.).—J. S. Foster and W. Rowles: Patterns and Paschen-Back Analogue in the Stark Effect for Neon.—J. K. L. MacDonald: Stark Effect in a Violet Region of the Secondary Spectrum of Helium.—J. S. Foster and M. L. Chalk: Relative Intensities of Stark Components in Hydrogen.—J. Chariton and G. A. Lea: (*a*) Some Experiments concerning the Counting of Scintillations produced by Alpha-Particles. Part I. (*b*) Some Experiments concerning the Counting of Scintillations produced by Alpha-Particles. Part II. The Determination of the Efficiency of Transformation of Kinetic Energy of the α-Particles into Radiant Energy. (*c*) Some Experiments concerning the Counting of Scintillations produced by Alpha-Particles. Part III. Practical Applications.—O. R. Baldwin: The Relativity Theory of Divergent Waves.—Dr. G. W. C. Kaye and W. F. Higgins: The Thermal Conductivity of Solid and Liquid Sulphur.—S. Barrett and C. P. Stein: On Bromine Chloride.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. G. Enderlein: Die Copeognathen-Fauna der Seychellen.—S. Maulik: Chrysomelid Coleoptera of the Subfamilies Eumolpinæ, Galerucinæ, and Halticinæ from the Islands of the Western Indian Ocean.—Prof. F. E. Lloyd: The Resistance of the Door of the *Utricularia* Traps to Water Pressure.—Dr. A. B. Rendle: A Remarkable Subterranean Orchid from West Australia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Gordon Home: Roman London (I.).

BIOCHEMICAL SOCIETY—UNIVERSITY OF BIRMINGHAM (at Birmingham University), at 5.30.—Prof. A. R. Ling: Presidential Address.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—A. J. Dale: Refractories for Use in Metallurgical Furnaces.

BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Public Library), at 7.30.—W. F. Vickers: Oils and Wool.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry, Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—Dr. J. D. M. Ross: X-Ray Analysis of Crystals.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Leicester Technical College), at 7.30.—A. J. Hall: Swelling of Fibres.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—E. F. Fincham: The Function of the Lens Capsule in the Accommodation of the Eye.—Dr. D. S. Perfect: A Double Reflection Level.—T. Smith, Dr. J. S. Anderson, and L. C. Cordle: Photographs of Reflexion Caustics.

CHEMICAL SOCIETY, at 8.—A. H. Dickins, W. E. Hugh, and G. A. R. Kon: The Chemistry of the Three-carbon System. Part XX. Cyclo Pentylideneacetone and Cyclopentylidenemethylethyl Ketone.—H. D. K. Drew: Non-existence of Isomerism among the Dialkyl Telluronium Dihalides.—C. S. Gibson and J. L. Simonsen: Indian Turpentine from *Pinus longifolia* Roxb. Part V. The Oxidation of *d*-Δ^3-carene with Beckmann's Chromic Acid Mixture.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr. E. Hindle: An Experimental Study of Yellow Fever.

BRITISH INSTITUTE OF RADIOLOGY, at 8.30.

SOCIETY OF DYERS AND COLOURISTS (West Riding Section) (at Bradford).—Prof. H. E. Fierz-David.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—Informal Discussion.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Dr. E. G. Ritchie: Steam Storage.

NELSON TEXTILE SOCIETY (at Nelson).—J. Smeaton: The Testing of Textile Materials and the Work undertaken by the Manchester Chamber of Commerce Testing House.

FRIDAY, JANUARY 18.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1.15.—J. P. O'Callaghan: Water Softening for the Textile Industries.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Present State of Knowledge concerning the Cortical Areas of the Human Brain.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—C. Gordon Smith: Common Salt.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—J. G. Weir: Modern Feed-Water Circuits.

INSTITUTION OF CHEMICAL ENGINEERS, (at Institution of Civil Engineers), at 6.30.—Prof. J. W. Cobb: The Reactivities of Solid Carbon in Fuel Processes (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—M. O. Dell: Some Recent Prints from the Pyrenees.

GLASGOW SOCIETY OF DYERS (at 7 Gordon Street, Glasgow), at 7.15.—A. J. Hall: The Action of Swelling Agents on Artificial Silk.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. F. Petree: Notes on the Fitting and Operation of Michell Bearings.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—Dr. J. J. Fox: The Examination of Paints.

ROYAL SOCIETY OF MEDICINE (Pathology, Surgery, and Obstetrics Sections), at 8.—Special Discussion on Post-operative Thrombosis. Openers: W. H. Evans (Pathology), D. H. Patey (Surgery), V. Bonney (Obstetrics).

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—C. T. Holland: Epiphyseal Injuries of the Wrist Joint.—Dr. R. S. Patterson: Some Factors Influencing Epiphyseal Growth and Union.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: Further Progress in Crystal Analysis.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section).—Dr. S. G. Barker: The Standardisation of Fastness of Dyestuffs on Dyed Fabrics.

TODMORDEN TEXTILE SOCIETY (at Todmorden).—H. P. Curtis: Cloth Testing and Examination from the Manchester Man's View.

SATURDAY, JANUARY 19.

GEOLOGISTS' ASSOCIATION (at Museum of Practical Geology, Jermyn Street), at 2.30.—Dr. R. Crookall: Demonstration of Coals, their Composition and Origin.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish and Belgian Art (I.): The Portrait.

PUBLIC LECTURES.

MONDAY, JANUARY 14.

UNIVERSITY COLLEGE, at 5.—G. P. Crowden: Fatigue. (Succeeding Lectures on Jan. 21 and 28.)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—R. T. Parkhurst: Poultry Research.

TUESDAY, JANUARY 15.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Distinguished Stars. (Succeeding Lectures on Jan. 16, 17, and 18.)

WEDNESDAY, JANUARY 16.

UNIVERSITY COLLEGE, at 5.—Dr. A. S. Parkes: The Physiology of Reproduction. (Succeeding Lectures on Jan. 23, 30, Feb. 6, 13, and 20.)

THURSDAY, JANUARY 17.

UNIVERSITY COLLEGE, at 5.—Dr. H. R. Ing: The Chemistry of some Natural Drugs. (Succeeding Lectures on Jan. 24, 31, Feb. 7, 14, and 21.)

BEDFORD COLLEGE FOR WOMEN, at 5.15.—T. A. Joyce: The Architecture of Central and South America.

FRIDAY, JANUARY 18.

UNIVERSITY COLLEGE, at 5.—C. F. Pantin: Comparative Physiology. (Succeeding Lectures on Jan. 25, Feb. 1, 8, 15, 22, Mar. 1, 8, 15, and 22.)

SATURDAY, JANUARY 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London through the Ages.

CONFERENCE.

FRIDAY, JANUARY 11.

ROTHAMSTED EXPERIMENTAL STATION, at 11.15 A.M.—The Hertfordshire Agricultural Situation: Can it be Improved? Chairman: Sir John Russell.

R. J. Thompson: Agricultural Production in Hertfordshire.

A. W. Street: Poultry as an Adjunct to the Farm (including Marketing of Eggs).

D. Crawford: Labour-saving Machinery as a Means of Lowering Costs of Production.

F. J. Prewett: Improved Methods of Milk Marketing by Pools and otherwise.

R. R. Enfield: The Ministry of Agriculture's Short Term Credit Scheme.

G. Dallas: Agricultural Labour in Hertfordshire.

J. Hunter Smith: The Place of the Oaklands Institute in the County Agriculture.